PROPOSAL FORM

BALTIMORE COUNTY
DEPARTMENT OF PUBLIC WORKS & TRANSPORTATION
TOWSON, MARYLAND

Division of Construction Contracts Administration

STRUCTURAL ENGINEER

Columbia Engineering
6210 Old Dobbin Lane; # 150
Columbia, Maryland 21045
PH: 410-992-9970

CIVIL ENGINEER

MK Consulting Engineers
1801 Porter Street; Suite 401
The Star Building
Baltimore, Maryland 21230
PH: 667-309-6193

LANDSCAPE ARCHTECT

Mahan Rykiel Associates, Inc.
3300 Clipper Mill Road
Baltimore, Maryland 21211
PH: 410-235-6001

ARCHITECT

Murphy & Dittenhafer Architects
805 North Charles Street
Baltimore, Maryland 21201
PH: 410-625-4823

MEP ENGINEER

Bowman Engineering
300 E. Joppa Road; Suite 501
Towson, Maryland 21286
PH: 410-494-1111

FIRE PROTECTION

Setty Engineering
575 S. Charles Street; Suite 404
Baltimore, Maryland 21201
PH: 667-309-3494

Contract Number 24111 PP0
Property Management Project
Wilkens Police Precinct New Building (LEED SILVER CERTIFICATION) –
901 Walker Avenue, Catonsville, Maryland 21228
Catonsville – District 1c1
Workday Number
PROJ-300200006

CONTRACT BASED ON SEPTEMBER 2023
STANDARD SPECIFICATIONS FOR CONSTRUCTION AND MATERIALS
AND STANDARD DETAILS FOR CONSTRUCTION

Bidders Information

A pre-bid meeting will be held on Wednesday, October 29, 2025 at 10:00 a.m. EST via WebEx. *Phone-In* (Audio Only) 1-415-655-0001, Meeting Number 2303 230 7730##. *Video Conference* go to https://signin.webex.com/join Meeting Number 2303 230 7730,**Password**: **sGSYKJsy538**, for Webex link go to: www.baltimorecountymd.gov/departments/public-works/engineering/contracts/current-solicitations **A site visit is scheduled for Thursday, October 30, 2025 @ 2:00 P.M. EST.**

Baltimore County Prevailing Wage & Local Hiring Affidavit, Requirements & Wage Rates **see pages 2024-2031**. **(Contract Disclosure):** "***Wage rates that are in effect as of the contract solicitation date will be the wage rates through the duration of the project***"

MBE/WBE Requirements & Forms **see pages 2032-2046**

THIS PROPOSAL FORM INCLUDES AND INCORPORATES ALL DOCUMENTS AND INFORMATION REFLECTED, LISTED, AND/OR REFERENCED IN THIS TABLE OF CONTENTS, AND ALL SUCH DOCUMENTS AND INFORMATION ARE PART OF AND INCORPORATED INTO THE CONTRACT DOCUMENTS.

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S E C T I O N I

INFORMATION FOR BIDDERS

ELECTRONIC SUBMITTAL PROCESS

To be considered, Bids (Section IV – Proposal) shall be received by the bid closing date and time to the following email address dpwbid@baltimorecountymd.gov. The contract number and company name should be referenced in the Subject Line of the email. Bids may not be submitted by any other means. Bids that are mailed or otherwise delivered to the Purchasing Division (including emails which indicate links to locations where the bid may be downloaded) and/or emails sent to any other Baltimore County email address will not be accepted.

Late Bids will not be considered. Bidders are strongly encouraged not to wait until the last minute to submit bids. The time stated on the auto-receipt (described below) will be definitive of the time of receipt. Bids received after the deadline will not be accepted. Bidders are advised that the County cannot receive email attachments greater in size than twenty-five (25) megabytes and this size limitation may be further reduced by requirements of the Bidder's email provider which are beyond the control of the County. Bidder should consider separating any large bid attachment into multiple parts and emailing each part separately. In such case, Bidder will note that each email is *1 of 2*, *2 of 2*, etc. Multiple part bids will not be considered unless all parts are received by the bid closing date and time.

After submitting a Bid to dpwbid@baltimorecountymd.gov, and upon successful receipt by the County thereof, Bidder will receive an auto-receipt email. This receipt is proof that the bid has been received by the Division of Construction Contracts Administration and should be retained for Bidder's records. In the case of a bid submitted in multiple parts as described above, an auto-receipt email will be generated for each part. The County has no obligation to consider any Bid for which an auto-receipt was not generated.

As with any system, power outages or technology problems may arise that are outside of the County's control and could affect your submission. The County will not be held accountable for such issues that may delay the transmission of any Bid.

NOTE: Electronic copy of the Bid Bond will be accepted at bid opening. The apparent low bidder is required to submit the original Bid Bond within ten (10) days after the bid opening to the Division of Construction Contracts Administration, 111 West Chesapeake Avenue, Room 300B, Towson, Maryland 21204.

INSTRUCTIONS AND SPECIFICATIONS

Refer to the enclosed proposal sheets for quantities to be bid upon. All proposals submitted on the attached form must give the price in clear figures for each item of the proposed work and be signed by the bidder with his name and address. Bidders must not change any item in the proposal for which a price has been stipulated by the County. Any change will cause rejection of the proposal.

NOTE: STATEMENT UNDER OATH FORM TO ACCOMPANY BID as per Baltimore County Purchasing Act 65-98, Section 15-94 and 15-95 which requires that the enclosed affidavit (see Proposal Affidavit pages in Section IV) be completed and submitted as part of the sealed bid.

Proposals made on any other than the attached form will not be considered. All papers included in, bound thereto, or attached to the Proposal Form are necessary parts thereof and shall not be detached, separated, or altered in their intent.

Changes in the phraseology of the proposal, additions, or limiting provisions will render the proposal informal or void and may cause its rejection.

All right is hereby reserved by the Purchasing Agent to reject any or all proposals and to waive formalities and technicalities as the interest of the County may require.

No successful bidder may withdraw his bid within NINETY (90) days after the opening thereof.

The successful bidder will be required to be bonded to Baltimore County, Maryland to the sum of One Hundred per Cent (100%) of the amount of his proposal or proposals according to the form of bond hereto attached for projects in excess of $25,000.00.

This Proposal must be accompanied by a Bid Bond in an amount of 5% of the bid, the exact amount to be determined by the difference between the low bid and the next lowest bid if two or more bids are received, or 5% of the bid if one bid is received. This guarantees payment of the amount thus determined in case of a default in any matter specified as required before award or in any matter resulting in failure to execute and deliver an Agreement, together with Payment and Performance Bonds, after award. The Bid Bond must be in the form accompanying the Proposal executed by a Surety licensed in the State of Maryland. The Surety must be currently rated "B" or better by the A. M. Best Company, and the bid must be in an amount less than, or equal to, the underwriting limitation contained in Department of Treasury Circular 570 as amended at the time of the underwriting.

All work to be performed under this contract shall be done under strict compliance with Baltimore County Department of Public Works and Transportation September 2023 Standard Specifications for Construction and Materials and Standard Details for Construction and any and all proposed revisions thereto as of the date of advertisement and copies of which are available on the County's website at www.baltimorecountymd.gov/departments/public-works/standards, and all of which are made a part hereof and incorporated herein (collectively, the "Specifications").

If the bidder to whom an award is made shall fail to execute the contract and bond hereto attached and as herein provided, the award may be annulled and the contract awarded to the lowest responsible bidder who has consented to a time extension, and such bidder shall fulfill every stipulation embraced herein as if he were the original party to whom the award was made, or the Purchasing Agent may reject all of the bids as the interest of the County may require.

The Bid Bond of the three lowest bidders is deemed to be effective until the execution and delivery of the Contract Agreement, together with Payment and Performance Bonds for projects in excess of $25,000.00 or until rejection of all bids, whereupon Surety is deemed relieved of all further obligations under the bid bonds provided.

Bidders must examine the drawings and specifications carefully and must make a personal examination of the location and nature of the proposed work. In case doubt shall arise as to the

meaning or intent of anything shown on the drawings or comprised in the specification, inquiry shall be made of the Director of Public Works and Transportation at least five (5) days prior to the date of bid opening. The submission of the Proposal shall indicate that the bidder thoroughly understands the drawings and the terms of the Specifications.

To better ensure fair competition and to permit a determination of the lowest bidder, unresponsive bids or bids obviously unbalanced may be rejected by the Purchasing Agent.

Bidders are required to fill out the total price column and total their proposals so that the result of the bidding, barring possible arithmetical errors, will be known at once. Any errors in computations will be corrected by the Engineer when the proposals are canvassed. Where the unit price and the total price are at variance, the unit price will prevail.

Bidders must be prepared to complete the work within the time stated in the proposal.

NOTE: ONLY CONTRACTORS FORMALLY PRE-QUALIFIED WITHIN THE ADVERTISED WORK CLASSIFICATION BY THE DIRECTOR OF PUBLIC WORKS AND TRANSPORTATON OF BALTIMORE COUNTY 10 CALENDAR DAYS PRIOR TO BID OPENING WILL BE ELIGIBLE TO SUBMIT BIDS.

Contracts for work under this proposal will obligate the contractors and subcontractors not to discriminate in employment practices. Bidders must, if requested, submit a compliance report concerning their employment practices and policies in order to maintain their eligibility to receive the award of the contract. Successful bidders must be prepared to comply in all respects with the Contract Provisions regarding nondiscrimination.

Baltimore County has adopted a Minority Business Enterprise (MBE) program and Women's Business Enterprise (WBE) Program. The percentage of participation applies to the contract amount awarded to the Contractor. Qualified minority subcontractors are those certified as being a Minority Business Enterprise by the following:

1. Maryland Department of Transportation Certification Committee (MDOT)

2. City of Baltimore, Minority Business Certification Council

Projects funded by the Federal Highway Administration are limited to the certification listed under #1 (MDOT).

More detailed information regarding the County's MBE/WBE Program can be obtained from the County MBE Office, telephone (410) 887-3407. See Executive Order dated December 6, 2022. MBE/WBE Participation Summary and Forms A, B, C, D and E enclosed in this proposal booklet.

NOTE: If you do not complete and submit the enclosed forms with your bid or offer to the County, the County may, in its sole discretion, deem your bid or offer **NON-RESPONSIVE** and accordingly the **COUNTY WILL NOT CONSIDER YOU FOR CONTRACT AWARD**.

The County reserves the right to require the low bidder to produce evidence indicating that the company's financial condition is equal to, or better than, that enjoyed by the company at the time of prequalification. This additional information may be in the form of a financial statement or other evidence satisfactory to the Office of Budget and Finance.

Bidders' attention is directed to the requirement that a permit must be obtained from the Baltimore County Bureau of Highways and Bureau of Traffic Engineering prior to cutting any County road for the purpose of obtaining sub-surface soils information, and permission must be obtained from the State Highways Administration prior to making any openings in a State road.

Under no circumstances shall a bidder enter upon any property outside a County or State road for the purpose of securing sub-surface soils information until permission is received from the property owner. The fact that the County has obtained a utility easement does not give the bidder the right to enter upon the property.

Prevailing index price of asphalt cement/ton $640.00**.**

INCLEMENT WEATHER POLICY: If Baltimore County General Government Offices are open or open with liberal leave the day the bids are due, the bids are due as stated in the bid documents (date and time). **ONLY** when the Baltimore County General Government Offices are **OFFICIALLY CLOSED** the day the bids are due, the bid date will be postponed and an Addendum will be issued the next business (or next day buildings are officially open) day the county offices are open with the new bid date and time.

BID TABULATIONS: All bid tabulations will be confidential until after final award, at which time the total bid amounts for all bidders, as well as the complete bid tabulations for the top three (3) bidders, can be inspected by others when requested in writing pursuant to the Maryland Public Information Act.

ALTERNATIVE SOURCES OF CONTRACT BONDS: In the event your company is unable to qualify for bonding through a traditional commercial surety company, you may qualify for the required bonds through the State of Maryland, Department of Commerce (DOC). The **Maryland Small Business Development Financing Authority (MSBDFA, pronounced Mis-Bid-Fa)**, an agency of DOC, operates a Surety Bond Program designed to assist small businesses, based in Maryland, that are unable to obtain adequate bonding on reasonable terms in the commercial marketplace. MSBDFA provides bid, payment and performance bonds for contracts funded by government agencies, regulated utilities and private entities. The penal sums of the bonds are limited to the aggregate amount of $2,500,000 and companies may pre-qualify for multiple bonds within pre-approved terms and conditions. MSBDFA also provides lines of credit, term loans and loan guarantees to help qualified businesses purchase equipment and real property, make improvements to leased property, refinance existing debt and assist them with their working capital needs. For more information on how to apply, you may contact: Meridian Management Group, Inc. (MMG), (the Program's Manager), 826 E. Baltimore Street, Baltimore, Maryland 21202, Telephone: (410) 333-4270. Or visit their website at www.mmgcapitalgroup.com for information, applications and a checklist of required documents and reports that must accompany the application.

S E C T I O N I I

SPECIAL PROVISIONS

MAINTENANCE BOND

Per the Baltimore County Department of Public Works and Transportation September 2023 Standard Specifications for Construction and Materials, Section GP – 4.10 (C) states, the contractor is required to post a maintenance bond in the amount of five (5) percent of the total cost of the contract or withhold five (5) percent retainage for two (2) years from the date of Final Acceptance.

BALTIMORE COUNTY, MARYLAND

BOND NO. _____

CONTRACT NO. _____

MAINTENANCE BOND

THIS MAINTENANCE BOND is entered into on this _____ day of _____, 20____, by and between _____ as principal ("Principal") and _____, a business entity that is authorized to transact business in the State of Maryland and is organized and existing under the laws of the State of _____, as surety ("Surety"), are held and firmly bound unto Baltimore County, Maryland, a body corporate and politic of the State of Maryland ("County"), as Obligee.

WHEREAS, the above-named Principal has entered into a written contract known as Contract Number _____ dated _____, 20___ with Obligee for _____ (the "Agreement"), the terms of which are hereby incorporated by reference; and

WHEREAS, Principal has completed construction under the Agreement; and

WHEREAS, the Agreement includes a warranty on the quality of the Work performed that runs for a period of two (2) years from the date of the County's final acceptance and that runs for two (2) additional years beyond the repair date if any repair is done during the warranty period; and

WHEREAS, Principal is required to cause this instrument to be executed and delivered to Obligee as security for maintenance during the warranty period in an amount equal to 5% of the total value of the Contract.

NOW, THEREFORE, the Principal and Surety are held and firmly bound unto the Obligee in the sum of $_____ Dollars ($ _____), lawful money of the United States of America, for the payment of which sum of money the Principal and Surety do bind themselves and their personal representatives, legal representatives, successors, and assigns, jointly and severally, firmly by this maintenance bond.

The conditions of this bond are as follows:

1. The Principal shall, for a period of two (2) years from and after the date of completion and acceptance of same by Obligee, replace all defects arising in the Work, whether resulting from defective materials, equipment, design furnished or workmanship. After such period, this obligation shall be null and void; otherwise it shall remain in full force and effect.

2. In the event of a default on the part of the Principal that may be the subject of a claim under this bond, Obligee shall mail, by certified mail, to Surety at the address listed below, a written statement that a claim is being made under the bond and, with substantial accuracy, the amount of the claim. Surety shall have no obligation to Obligee under this bond until the notice of claim is mailed.

3. When the Obligee has satisfied the condition of Paragraph 2 that a notice of claim be mailed, the Surety shall promptly and at the Surety's expense send an answer to Obligee within 30 days after the date of the claim. The answer shall state the amounts that are undisputed and the basis for challenging any amounts that are disputed. The answer shall be accompanied by payment (or arrangements for immediate payment) of any undisputed amounts.

4. Surety expressly waives any right to receive notice of extensions of time or alterations or modifications to the Agreement that may be granted by Obligee and agreed upon by Principal, and any such extensions, alterations, or modifications shall not affect the obligation of the Surety under this bond.

5. This bond is a specialty governed by the twelve-year statute of limitations period set forth in the Annotated Code of Maryland Courts and Judicial Proceedings §5-102.

WITNESS OR ATTEST:

_____

_____
(Principal – Contractor Name)

By:_____

Type Name:_____

Type Title: _____

Date: _____

_____
(Surety)

_____

By:_____

Type Name:_____

Type Title:_____

Type Address:_____

_____

Date:_____

The Contract shall be done in strict compliance with the Baltimore County Department of Public Works and Transportation September 2023 "Standard Specifications for Construction and Materials" and "Standard Details for Construction", and any and all revisions thereto as of the date of the fully executed Contract, including but not limited to the General Conditions Building Projects, as applicable, and all of which are made a part hereof and incorporated herein (collectively, the **"Specifications").** Copies of which are available on the County's website at www.baltimorecountymd.gov/departments/public-works/standards. **IN ADDITION, THE CONTRACTOR UNDERSTANDS AND AGREES THAT THE FOLLOWING SECTIONS OF THE SPECIFICATIONS (GP-1.03 AND GP-5-15) SHALL BE STRICKEN AND THE FOLLOWING SHALL BE INSERTED IN AND INCORPORATED INTO THE CONTRACT IN LIEU THEREOF:**

GP-1.03 ORGANIZATIONAL DEFINITIONS

Administration - Baltimore County.

Administrator - The Director of the Office of Budget and Finance, Baltimore County.

Baltimore County - Baltimore County, Maryland: a body corporate and politic.

Department - The word "Department" shall mean the Office of Budget and Finance of Baltimore County.

Engineer - One of the following engineering executives:

Director of Office of Budget and Finance
Chief, Property Management Division of the Office of Budget and Finance

Any delegation of the Engineer's authority must be authorized in writing by any one of the above listed officials, and such delegation of authority will pertain only to the specific contract and/or contracts shown by the authorization. The title of the specific official will appear in those cases within these specifications where the word "Engineer" as defined herein is not sufficiently specific.

Inspector - The authorized representative of the procurement officer assigned to make detailed inspection of any or all portions of the work, or materials therefor.

Procurement Officer - See Engineer.

GP-5.15 DISPUTES

(a) Except as otherwise may be provided by applicable law or regulation, all disputes arising under or as a result of a breach of this Contract that are not disposed of by mutual agreement shall be resolved in accordance with this General Provision.

(b) As used herein, "claim" means a: written demand or assertion by one of the parties seeking, as a legal right, the payment of money, adjustment or interpretation of Contract terms, or other relief, arising under or relating to this Contract.

A voucher, invoice, or request for payment that is not in dispute when submitted is not a claim under this General Provision. However, if the submission subsequently is not acted upon in a reasonable time, or is disputed either as to liability or amount, it may be converted to a claim for the purpose of this General Provision.

(c) When a claim cannot be resolved by mutual agreement, the Contractor shall submit a written request for decision to the Department's Chief of the Property Management Division for his decision in consultation with the County Office of Law. The Contractor's written request shall set forth all the facts surrounding the controversy, including, but not limited to, those items listed in GP-5.14(b). Any claim by the County shall be decided in like manner.

(d) The Contractor, at the discretion of the Engineer, may be afforded an opportunity to be heard and to offer evidence in support of his claim. Pending resolution of a claim, the Contractor shall proceed diligently with the performance of the Contract.

(e) The Department's Chief of the Property Management Division shall decide any and all claims. The decision by the Department's Chief of the Property Management Division shall be issued within ninety (90) Days on matters of less than fifty thousand dollars ($50,000) and within one hundred eighty (180) Days on matters of fifty thousand dollars ($50,000) or more. The written decision of the Department's Chief of the Property Management Division shall be final and binding unless appealed in writing to the Director of the Department within thirty (30) Days of the Chiefs written opinion to the parties. If the Chiefs decision is timely appealed in writing to the Director of the Department, the Director of the Department, serving as referee, will review the written appeal submitted to assure all reasonable attempts were made to resolve the appeal.

(f) The Director shall issue his/her decision in writing within ninety (90) Days. The Director's decision shall be final and conclusive unless a written appeal is mailed or otherwise filed with the County Administrative Officer within thirty (30) Days of the Director's written decision.

(g) When the County Administrative Officer is satisfied all efforts at the Department level were made to resolve the dispute, a claim shall be resolved as follows:

(1) Subject to, and without in any way enlarging or limiting the other provisions of the Contract, the parties to any Agreement which adopts or incorporates by reference these Standard Specifications, appoint the County Administrative Officer as an administrative hearing officer pursuant to Article 25A, "Chartered Counties of Maryland", of the Annotated Code of Maryland.

(2) The parties further grant the County Administrative Officer the right to delegate this responsibility and authority in writing to a County official who is a registered professional engineer, independent of the Department of Public Works and Transportation’s Division of Construction Contracts Administration, or to any other County official.

(3) For disputes involving ten thousand dollars ($10,000) or more the decision of the administrative hearing officer shall be final and binding on both parties, subject only to such appeals on the record as provided by Article 25A. For disputes involving less than ten thousand dollars ($10,000), the decision of the administrative hearing officer shall be final and binding on both parties.

GENERAL CONDITIONS

BUILDING PROJECTS

Revised September 1, 2024,
in compliance with September 2023
Standard Specifications for Construction and Materials

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BUILDING PROJECTS

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GENERAL CONDITIONS
DESIGN BUILD BUILDING PROJECTS

I. SPECIFICATIONS

Article 1 Applicable Specifications

All work performed under this Contract shall be done under strict compliance with the *Specifications* bound herewith, and with the *Baltimore County Standard Specifications for Construction and Materials* and the *Standard Details for Construction* dated September 2023 and subsequent addenda thereto, so far as the same may be applicable, copies of which are available on the County's website at www.baltimorecountymd.gov/departments/public-works/standards. These General Conditions are in addition to the aforementioned Specifications. Should there be any conflict with the aforementioned manuals, the *General Conditions* take preference.

II. DEFINITIONS

Article 2 Definitions

A. *Architect and/or Engineer* shall mean the registered Architect and/or Engineer commissioned by the County to prepare the plans and contract documents.

B. *Engineer* in these General Conditions and in the Construction Specifications in some instances refers to authorized representatives of the Office of Budget and Finance, Property Management.

C. *Subcontractor,* as employed herein, includes only those having a direct contract with the Contractor. It includes one who furnished material worked to a special design according to the Plans and Specifications for the "work." It excludes one who merely furnished material not so worked.

D. *Written Notice* shall be deemed to have been duly served if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered to or sent by registered mail to the last business address known to him who gives the notice.

E. *Repair* means to restore after injury, deterioration, or wear; to mend, to renovate, by such means as appropriate, and to supply such materials and labor as necessary to render the item to be repaired sound, solid, true, plumb, square, even, smooth, and fully serviceable. Upon completion of such repair it must be, unless otherwise stated, rendered to such condition as to present a first-class finished work, or in instances where the repaired item serves as a base for additional finish, the repaired work must be such as to permit a first-class finish, to be applied without extra cost to the County. When the word "repair" is used in connection with machinery or mechanical equipment, it shall mean, in addition to the above, rendering the equipment completely serviceable and efficient, ready for the normal use for which it was originally intended.

F. Some parts of the "Construction Specifications," bound herewith are of the abbreviated or "streamlined" type and includes incomplete sentences. Omissions of words or phrases such as "the Contractor shall", "in conformity therewith", "shall be", "as noted on the drawings", "according to the plans", "a", "an", "the", and "all" are intentional. Omitted words or phrases shall be supplied by inference in the same manner as they are when a "note" occurs on the drawings. Words "shall be" or "shall" will be supplied by inference when colon (:) is used within sentences or phrases.

Article 3 Time Limits

The proposal shall indicate whether the contract limit is based on Working Days or Calendar Days. If this is not indicated in the Proposal, then the time limits will be based on Calendar Days.

Article 4 Sunday, Night and Holiday Work

If Sunday, night or holiday work is necessary due to an emergency or is permitted by the Engineer, the Contractor shall secure and pay for any and all permits required in connection with this work.

III. CONTRACT DOCUMENTS AND SHOP DRAWINGS

Article 5 Contract Documents

A. Clarification

It is assumed that the Contractor has obtained clarification of all questions which may have arisen as to intent of the contract documents, or assumed, or actual conflict between two or more items in the Contract Documents as required in "Instructions to Bidders." Should the Contractor have failed to obtain such clarification as required by the "Instructions to Bidders," then the Engineer may direct the work to proceed by any method indicated, specified or required by the Contract Documents in the interest of maintaining the best construction practice. Such direction by the Engineer shall not constitute a claim for extra by the Contractor.

B. Jargon

Work described in words that have a well-known technical or trade meaning shall be held to refer to such recognized standard use.

C. Drawings

The Contractor shall do no work without proper drawings and instructions. Drawings are, in general, drawn to scale; however, symbols are used to indicate materials and structural and mechanical requirements. When symbols are used, the drawings are, of necessity, diagrammatic, as it is not possible to indicate all connections, fittings, fastenings, etc., which are included as a part of the work. Diagrammatic indication of mechanical piping, ducts, and conduit within the buildings is subject to adjustment in order to obtain proper grading, passage over, under or past obstructions, to avoid exposure in finished rooms and unsightly and obstructing conditions. The Contractor shall coordinate these adjustments.

1. Copies no longer Furnished

   The County will no longer furnish the Contractor any copies of the Drawings and Specifications. Additional copies may be obtained by the Contractor down loading drawings and specifications from the Baltimore County Solicitation Web Page.

2. Copies of the Work

   The Contractor shall keep in the office on the job a complete set of all drawings, specifications, shop drawings, schedules, etc., in good order and available to the Engineer and representatives of the County.

3. Ownership

   All documents as furnished by the County remain the property of the County. They must not be used on other work but shall be returned to the County upon completion of the work.

D. Large Scale Detail Drawings

The Architect shall furnish, when necessary, additional instructions in the form of large scale developments of the drawings used for bidding, or to amplify Construction Specifications for the proper execution of the work. These shall be true developments of the bidding documents and reasonably inferable there from. The work shall be executed in conformity herewith. [See Article 6, Paragraph A.3.(c)]

E. Dimensions

The Contractor shall carefully check all dimensions prior to execution of the particular work affected. Whenever inaccuracies or discrepancies are found, the Contractor shall consult the Engineer prior to any construction or demolition. Should any dimensions be missing, the Engineer will be consulted and supply them prior to execution of the work. Dimensions for items to be fitted into constructed conditions at the job will be taken at the job and will be the responsibility of the Contractor. The obvious intent of the documents or obvious requirements dictated by conditions existing or being constructed supersedes dimensions or notes which may be in conflict herewith.

Whenever a stock size manufactured item or piece of equipment is specified by its nominal size, it is the responsibility of the Contractor to determine the actual space requirements for setting or entrance to the setting space. No extra will be allowed by reason of work requiring adjustment in order to accommodate the particular item of equipment.

Whenever new work, building, addition or portions thereof are not accurately located by plan dimensions, the Engineer will supply exact position prior to execution of the work.

Article 6 Shop Drawings

A. Shop Drawings (those prepared by the Contractor or Vendor of Material)

The Contractor shall submit for the Architect's approval, at such times as agreed (see Article 8), shop drawings (to include setting drawings and schedules) as required for the work of the various trades. These drawings shall be prepared in conformity with the best practice and standards for the trade concerned. Due regard shall be given to speed and economy of fabrication and erection.

1. Items to be Detailed

Shop details shall be supplied for all items which are specially fabricated for the work or when the assembly of several items is required of a working unit. Shop drawings are required for all reinforcing and structural steel, specially made or cut masonry units, miscellaneous metal work, specially made flashings or roofing and sheet metal work, specially made millwork, special rough hardware and all heating, ventilating, plumbing and electrical requiring special fabrication or detailed connections, including ducts.

2. Submissions

Shop drawings, brochures and catalog cut submissions shall consist of sufficient copies to provide for the retention by the Architect and County of five (5) copies total plus such additional copies as the Contractor may require. Drawings shall not exceed 24 in. x 36 in. in size.

3. Examination and Approval

The Contractor shall review all shop drawings, brochures and catalog cuts provided by the subcontractors and vendors prior to submitting them to the Architect. The Architect shall examine shop drawings with reasonable promptness, noting desired corrections, or granting approval.

a. Field Dimensions and Conditions

The Architect is not responsible for the checking of dimensions or existing conditions in the field. This is the sole responsibility of the Contractor.

b. Resubmission

When the Architect's notations or corrections are extensive, then the Contractor shall resubmit the drawings with changes made on the drawings.

c. Contractor's Responsibility

Unless the Contractor has in writing, notified the Architect to the contrary, at the time of submission, it will be assumed that the drawings are in conformity with the Contract Documents and do not involve any change in the Contract price or any change which will alter the space within the structure or alter the manner of operation from that contemplated in the Contract Documents.

d. Architect's Notations

Should the Contractor consider any change or notation received in compliance with paragraph (c) above as increasing the cost of the work from that contemplated in the Contract Documents, then the Contractor shall desist from further action relative to the item he/she questions and shall notify the Engineer, in writing, within five (5) days of the additional cost involved. No work shall be executed until the entire matter is cleared or a Change Order issued, or the Contractor is ordered by the Engineer to proceed under the provisions of the County's Standard Specifications. Failure of the Contractor to serve written notice, as above required, shall constitute a waiver of any claim in relation thereto.

(1) Similarly, should the Architect's notation or change involve less work than is covered by the Contract Documents, the Contractor shall allow the County the credit resulting from the change.

(2) Should the Contractor consider that any notation or change made by the Architect under provisions of this paragraph, paragraph (c), above, as involving a complete change in the subcontractor's relation or the substitution of a material different from that on which the Contract was based, then the Contractor shall act as herein stated or as in paragraph (c) above.

4. Project Completion

At the completion of the project, the Contractor shall submit a list of shop drawings for the entire project. This list shall contain the following information: title, description, specialty (Architectural, Structural, Mechanical, etc.), decision (no exceptions taken, approved, approved as noted, etc.).

Article 7 Separate Contracts

A. The County reserves the right to let other contracts in connection with paving and utilities adjoining this work. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work, and shall properly connect and coordinate his work with theirs.

B. If any part of the Contractor's work depends for proper execution or results upon the work of any other contractor, the Contractor shall inspect and promptly report to the Engineer any defects in such work that render it unsuitable for such proper execution and results. Failure to inspect and report shall constitute an acceptance of the other contractor's work as fit and proper for the reception of the work, except as to the defects which may develop in the other contractor's work after the execution of the work.

C. To ensure the proper execution of his/her subsequent work, the Contractor shall verify work already in place and shall at once report to the Engineer any discrepancy between the executed work and the drawings.

IV. PAYMENTS

Article 8 Payments

A. Under this Contract payments will be made monthly on the valuation of work accomplished and on account of materials delivered on the site, for incorporation in the work, which are suitably stored.

B. At the first of each month, the Contractor shall submit to the Engineer an application for payment on a form provided by the Engineer. Prior to application for first payment, the Contractor shall submit to the Engineer a schedule of values for the various parts of the work, including quantities, aggregating to the total sum of the Contract. This shall be so divided as to facilitate payment to subcontractors in accordance with Article 28, Paragraph C.1. The form of this submission shall be such as the Contractor or Engineer have agreed upon, and, if required, shall be supported by such evidence as to its correctness as the engineer may direct. This schedule, when approved by the Engineer, shall be used as a basis for approval of payment unless it is found to be in error. In applying for payment, the Contractor shall submit a statement based upon the schedule, itemized in such form and supported by such evidence as the Engineer may require, showing the Contractor's right to the payment claimed. If required, the Contractor shall show receipts and other vouchers for the payments for materials and labor including payments to subcontractors, as required by Article 28.

C. Materials Purchased Under Allowance

The Engineer will provide schedules for all materials to be purchased from specified allowance.

Article 9 Approval of Payments

If the Contractor has made application, as above, the Engineer shall review and approve such payments as is decided to be properly due in accordance with the approved schedule. In approving such partial payments, there shall be retained no more than 10% of the total amount for the first 50% of the contract, after which only 5% of the total amount of the contract may be withheld unless the need is demonstrated for retaining more to protect the public interest.

Article 10 Payment Withheld

A. The Engineer may withhold, or on account of subsequently discovered evidence, nullify the whole or a part of any payment to such extent as may be necessary to protect the County from loss on account of:

1. Defective work not remedied.

2. Claims filed, or reasonable evidence indicating probable filing of claims, by parties other than the Contractor.

3. Failure of the Contractor to make payments properly to subcontractors or for material or labor.

4. A reasonable doubt that the Contract can be completed for the balance then unpaid.

5. Damage to another Contractor.

6. Failure of the Contractor to submit data required within the time limits stated in the Contract Documents.

Upon removal of the above, payment shall be made for the amounts withheld.

Article 11 Changes in Work

A. The County, without invalidating the Contract, may order changes in the work by altering, adding to or deduction from the work, the Contract sum being adjusted accordingly. Such change shall be executed under these *General Conditions.* Extension of time made necessary thereby shall be adjusted at the time of such Change Order.

B. The Engineer shall have authority to make minor changes in the work not involving extra cost and not inconsistent with the purpose of the project. Otherwise, except in an emergency endangering life or property, no extra work or change shall be made unless a written order for the Office Budget and Finance, Property Management signed or countersigned by the Director has been received by the Contractor. No claim for addition to the Contract sum shall be valid unless so ordered.

C. The value of any such extra work or change shall be determined in one or more of the following ways as determined by the Office of Budget and Finance, Property Management.

1. By Estimate and Acceptance of a Lump Sum

a. The prime Contractor shall furnish a breakdown of the estimated construction cost. The breakdown shall be of sufficient detail to describe the extra work and related costs for labor, material, overhead and profit.

b. Overhead and Profit

(1) Extra work by Subcontractor:

Subcontractor will be allowed 10% overhead and 10% profit added to the direct labor and material costs. The prime contractor will be allowed to increase the subcontractors total lump sum by 10% to cover his/her administration.

(2) Extra work by Prime Contractor:

The prime contractor will be allowed 10% overhead and 10% profit added to the labor and material costs.

c. The prime contractor will be allowed 1 % for the bond added to the labor and material costs.

d. The allowed overhead will include all supervision; no additional allowance will be made for it.

2. By Unit Prices Named in the Contract or Subsequently Agreed Upon

Such unit prices are to include all supervision, overhead, taxes, insurance and profit.

3. By Cost and a Fixed Fee

Added to the cost is a fixed fee portion which is to include supervision, overhead, insurance and profit.

4. By Force Account (Labor and Material Cost plus)

In accordance with the *Baltimore County Specifications for Construction and Materials* Section GP 9.02, the Contractor is allowed to add 65% mark-up.

D. Should none of the methods stated in Paragraph C. 1, 2, or 3 be determined, the Contractor shall, providing he/she receives an order as defined in Paragraph B, above, proceed with the work on the basis of Paragraph C. 4. Force Account.

The Contractor and Engineer shall keep accurate costs, in such form as the Engineer may direct, for presentation, together with vouchers, to the Office of Budget and Finance Property Management for determination of the value of the work included in each Change Order. Pending determination of the final value, the Engineer may include payments for materials and labor, as stated in Article 8, in monthly vouchers.

Article 12 Claims for Extra Cost

No claim for extra will be granted which includes cost of delays or work stoppage due to strikes, lockouts, fire, avoidable casualties or damage or delay in transportation for which the County or its agents are not responsible. (See also Article 14.)

Article 13 Deductions for Uncorrected Work

If the Engineer and County deem it expedient to correct work injured or done not in accordance with the Contract, an equitable deduction from the Contract price shall be made therefore.

Article 14 Delays and Extension of Time

If no schedule or agreement stating the dates upon which drawings shall be furnished is made (see Article 8), then no claim for delay shall be allowed on account of failure to furnish drawings until two (2) weeks after demand for such drawings, and then not unless such claim is reasonable.

Article 15 Correction of Work After Final Payment

Neither the final certificate nor payment nor any provision in the Contract Documents shall relieve the Contractor of responsibility for faulty materials and workmanship. Unless otherwise specified, the Contractor shall remedy any defects and pay for any damage to other work resulting there from that appears within the guarantee period. The County shall give notice of observed defects with reasonable promptness. All questions arising under this Article shall be decided by the Director of Budget and Finance, Property Management.

Article 16 (Deleted)

Article 17 Assignment

The Contractor shall not assign the Contract. It shall not be sublet as a whole or sublet by trades or other portions in an amount of more than 75% of the monetary value of the Contract. The remaining 25% shall be executed by the Contractor with labor and materials directly purchased and paid for by the Contractor. Costs for insurance, over-head, supervisions, etc., may not be claimed as a portion of the 25% mentioned above. The execution of work by a subsidiary of the Contractor is not considered direct employment. The Contractor shall not assign any monies due or to become due to him/her hereunder, without the previous written consent of the County.

Article 18 Maryland State Sales Tax

A. Contractors who are performing work for the State of Maryland or any of its political subdivisions are required to pay tax on materials and supplies which will be incorporated into the work.

B. The Contractor must pay the tax on all equipment which is purchased, Even though it may be used on a job for the State of any of its political subdivisions.

V. MATERIALS

Article 19 Materials

Materials include all manufactured products and processed and unprocessed natural substances required for completion of the Contract. The Contractor in accepting the Contract is assumed to be thoroughly familiar with the materials required and their limitations as to use and requirements for connections, setting, maintenance and operation.

Whenever an article, material or equipment is specified and a fastening, furring, connection (including utility connections), bed or accessory is normally considered essential to its installation in good quality construction, such shall be included as if fully specified. Nothing in the Construction Specifications shall be interpreted as authorizing any work in any manner contrary to applicable law, codes or regulations (See Article 31).

A. Approval

All materials are subject to the Architect's or Engineer's approval as to conformity with the specifications, quality, design, color, etc. No work for which approval is necessary shall be contracted for, or used, until written approval is given by the Architect or Engineer. Approval of a subcontractor, as such, does not constitute approval of a material which is other than that included in the Construction Specifications.

B. New Materials

Unless otherwise specified, all materials shall be new.

C. Quality

Unless otherwise specified, all material shall be of the best quality of the respective kinds.

D. Samples

The Contractor shall furnish for approval all samples as directed. The work shall be the same as the approved samples.

E. Painting and Color

The Architect and Contractor shall jointly prepare the paint and color schedules. The Architect shall direct the exact color, texture and finish.

F. Proof of Quality

The Contractor shall, if required, furnish satisfactory evidence as to the kind and quality of materials either before or after installation. The Contractor shall pay for any tests as may be deemed necessary in relation to "Substitutions" (Paragraph I. below).

G. Contractor's Option

When several products or manufacturers are named in the Construction Specifications for the same purpose or use, then the Contractor shall select any of those so named. However, all of the units of a thing required for a project must be the same in material and manufacture.

H. "Or Equal", "Equal", "Approved Equal"

The above terms are used as synonyms throughout the Construction Specifications. They are implied in reference to all named manufacturers. Only materials that, in the opinion of the Engineer, are fully equal in all details of construction, methods of assembly, finish and design quality will be considered. (See A, C, E, above, and I. below.)

I. Substitutions

Should the Contractor desire to substitute another material for one or more specified by name, the Contractor shall apply, in writing, for such permission and state the credit or extra involved by the use of such material. The Engineer will not consider the substitution of any material different in type or construction methods unless such substitution effects a benefit to the County. (See A. and D. above.)

The Contractor shall <u>not</u> submit for approval, materials other than those specified without a written statement why such a <u>Substitution</u> is proposed. Approval of a "substitute" material by the Architect or Engineer when the Contractor has not designated such material is a "substitute," shall not be binding on the County nor release the Contractor from any obligations of the Contract, unless the Architect or Engineer approves such "substitutions" in writing.

J. Standard Specifications

Whenever references are made in the Contract Documents to the *Baltimore County Standard Specifications for Construction and Materials* and *Standard Details for Construction,* it shall be understood that the latest standards and/or requirements are intended and shall apply. When no specification is cited and the quality, processing, composition or method of installation of a thing is only generally referred to then:

1. For things not otherwise specified below, the latest edition of the Applicable American Society for Testing Materials Specifications shall apply.

2. For things covered by the applicable portions, the National Bureau of Fire Underwriters Code shall apply.

3. For things generally considered as plumbing and those things requiring plumbing connections, the applicable portions of the latest edition of the American Society of Mechanical Engineers Code and the Baltimore County Plumbing Code shall apply.

4. For things generally considered as heating and ventilating work and not covered by A.S.M.E. Code, the applicable portions of the latest edition of the Heating and Ventilating Guide, published by the American Society of Heating and Ventilating Engineers, and the Baltimore County Building Code shall apply.

K. Storage

The contractor shall confine apparatus and storage of materials to the "off-road" area delineated as the "Limit of Contract." The Contractor shall not load or permit any part of the structure to be loaded with a weight that will endanger the safety of the structure or any part thereof.

VI. QUALIFICATION, EMPLOYEES, WORKMANSHIP, SUBCONTRACTORS AND ADVERTISING

Article 20 Qualification of Bidders

Bidders are required to be prequalified 10 days prior to bid opening, satisfactorily evidencing that they have the ability, equipment, organization and financial resources sufficient to enable completion of the work satisfactorily within the time specified in the Proposal.

Article 21 Employees and Workmanship

A. Employees

1. Qualification

Only personnel thoroughly trained and skilled in the task assigned them may be employed on any portion of the work, or they shall be removed.

2. Licensed

When County, State or Federal laws require that certain personnel (electricians, plumbers, etc.) be licensed, then all such personnel employed on the work shall be so licensed.

B. Quality of Labor

The Contractor shall employ on the work, at all times, sufficient personnel to complete the work within the time stated in the Proposal.

C. Work Areas

The Contractor shall confine the operations of his/her employees to the limits as provided by law, ordinance, permits or directions of the Office of Budget and Finance Property Management. Generally, the "off-road" area will be the same as the "limit of Contract" line.

D. Methods and Quality

1. All workmanship shall be of good quality. Whenever the method of the work or manner of procedure is not specifically stated or shown in the Contract Documents, then it is intended that the best standard practice shall be adhered to. Recommendations of the manufacturers of approved materials shall be considered as a part of Construction Specifications and all materials shall be applied, installed, connected, erected, used, cleaned and conditioned as so called for thereby. This, however, does not remove any requirement in Construction Specifications to add to the manufacturer's recommendations.

2. All materials shall be accurately assembled, set, etc., and when so required in good construction, shall be true to line, even, square, plumb, level and regularly spaced, coursed, etc. Under no circumstances, either in new or old work, shall any material be applied over another which has not been thoroughly cleaned, sanded or otherwise treated so as not to impair the finish, adhesion, or efficiency of the next applied item.

3. All methods, procedures and results are subject to the Engineer's approval as to finished result to be obtained. However, this is not to be interpreted as placing upon the Engineer any responsibility for the "work" management which is solely the responsibility of the Contractor.

E. Joining of Work

1. The Contractor shall so schedule the work as to ensure efficient and uninterrupted progress and to hold to an absolute minimum the cutting and patching of new work. All cutting, patching and digging necessary to the execution of the work is included.

2. The Contractor shall so schedule (to include subcontracts) the construction performed by each group or trade that each installation or portion of the construction shall member with and join with all other work as required for a complete installation, all according to accepted good construction practice.

F. Superintendent

The Contractor shall keep on the work, at all times during its progress, a competent superintendent and all necessary assistants, all approved by the

Office of Budget and Finance Property Management. Prior to commencement of the work, the Contractor shall submit in writing to the Office of Budget and Finance Property Management the name and qualifications of the person to be employed as Superintendent for the execution of the Contract. A written approval or rejection will be given following review of the data. Persons who have previously proved unsatisfactory on work executed for the County, or who are without proper qualifications, will not be approved. Should the Superintendent be complained of by the Office of Budget and Finance Property Management for cause, he/she shall be removed from the work. Should it be necessary to change the Superintendent, the above procedure shall be repeated. The Superintendent will represent the Contractor. All directions given to the Superintendent shall be as binding as if given to the Contractor. Important directions shall be confirmed on written request in each case.

G. Discipline

The Contractor shall at all times enforce strict discipline and good order among his/her employees and shall not employ or permit to remain on the work any unfit person. The Contractor shall enforce all instructions relative to use of water, heat, power, no smoking, and control any use of fires, as required by law and for the Office of Budget and Finance Property Management. Employees must not be allowed to loiter on the premises before or after job working hours.

Article 22 Employment Lists

The Contractor may contact MARYLAND STATE EMPLOYMENT SERVICE, Towson, MD, 21204, if so desired, for additional labor regarding this project.

Article 23 Contractor's Supervision (Also see Article 21, Paragraph F.)

The Contractor shall constantly maintain efficient supervision of the work, using his/her best skills and coordinating ability. The Contractor shall carefully study and compare all drawings, specifications, and other instructions and check them against conditions existing or being constructed on the project. The Contractor shall report to the Engineer any error inconsistency or omission which may be discovered. (See also Article 5, Paragraph E, and Instructions to Bidders.) The Contractor shall not be held responsible for the existence or discovery of such errors or conflicts and neither shall the adjustment of such errors or conflicts be grounds for claim for extra on the art of the Contractor unless such adjustment involves work not obviously contemplated by the Contract Documents or necessary to progress of the work. The Contractor shall be responsible for the coordination of the work of all subcontractors.

Article 24 The County’s Right to do Work

If the Contractor should neglect to prosecute the work properly or fail to perform any provision of this Contract, the County after three days' written notice to the Contractor may, without prejudice to any other remedy, make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor.

Article 25 County's Right to Terminate Contract

A. Terminate Contract

The Office of Budget and Finance, Property Management, upon proof that sufficient cause exists to satisfy such action, may without prejudice to any other right or remedy, and after giving the Contractor seven (7) days' written notice, terminate the employment of the Contractor and take possession of the premises and of all materials, tools, and appliances thereon and finish the work by whatever method may be deemed expedient, if any of the following conditions exists:

1. If the contractor should

   a. Be adjudged a bankrupt or make a general assignment for the benefit of creditors,

   b. Has a receiver appointed on account of insolvency.

   c. Fails to or repeatedly and persistently refuses to supply properly skilled workers or proper materials, except in cases for which extension of time is provided,

   d. Fails to make payment to subcontractors, or for materials and labor,

   e. Persistently disregards laws, ordinances or the instructions of the Engineer, or

   f. Is otherwise guilty of a substantial violation of any provision of the Contract.

2. Payment Status

   In cases such as identified above, the Contractor shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the Contract price shall exceed the expenses of finishing the work, including compensation for additional managerial and administrative services, such excess shall be paid to the Contractor. If such expense shall exceed such unpaid balance, the contractor shall pay the difference to the County. The expense incurred by the County as herein provided, and the damage incurred through the Contractor's default, shall be itemized by the Engineer and a certified copy supplied to the Contractor.

Article 26 Sanitary Conveniences

A. The Contractor shall arrange for the erection and Maintenance of temporary toilets equipped with running water and drain connection for use of employees. These conveniences shall be erected and kept clean and in good condition, as required by law, until ordered removed by the Engineer.

B. In lieu of A. above, the Contractor may install a portable approved chemical toilet at an approved location.

C. The permanent plumbing fixtures to be constructed under this Contract shall not be used during construction, under any circumstances.

Article 27 Subcontracts Deleted

Article 28 Relation of Contractor and Subcontractor

A. **The Contractor agrees** to bind every subcontractor and every subcontractor agrees to be bound by the terms of the Agreement, *Baltimore County's Standard Specifications for Construction and Materials* and *Standard Details for Construction* the *General Conditions,* the Drawings and Construction Specifications, as far as applicable, to his/her work, including the following provisions of this Article, unless specifically noted to the contrary in the subcontract approved in writing as adequate by the Office of Budget and Finance, Property Management.

B. **The Subcontractor agrees** to be bound to the Contractor by the terms of the Agreement, *Baltimore County's Standard Specifications for Construction and Materials* and *Standard Details for Construction, General Conditions,* Special Provisions, Construction Specifications, and to assume towards him/her all obligations and responsibilities that he/she, by those documents, assumes towards the County.

1. To submit to the Contractor applications for payment in such reasonable times as to enable the Contractor to apply for payment under Article 8 of these *General Conditions.*

2. To make all claims for extras, for extensions of time and for damages for delays or otherwise, to the Contractor in the manner provided in *Baltimore County's Standard Specifications for Construction and Materials* or those *General Conditions* for like claims by the Contractor upon the County, except that the time for making claims for extra cost is one (1) week.

C. **The Contractor agrees** to be bound to the Subcontractor by all the obligations the County assumes to the Contractor under Agreement, *Baltimore County's Standard Specifications for Construction and Materials, General Conditions,* Drawings and Construction Specifications, and by all the provisions thereof affording remedies and redress to the Contractor from the County.

1. To pay the Subcontractors:

   a. Upon receipt of payment, if issued under the schedule of values described in *Baltimore County's Standard Specifications for Construction and Materials,* G.P.-9.03 or Article 8 of these *General Conditions,* the amount allowed to the Contractor on account of the Subcontractor's work, to the extent of the Subcontractor's interest herein.

   b. Upon the receipt of payment, if issued otherwise than as in Paragraph C.1., above, so that at all times the total payments shall be as large in proportion to the value of the work done by him as the total amount certified to the Contractor is to the value of the work done by him/her.

   c. To such extent as may be provided by the Contract Documents or the subcontract, if either of these provides for earlier or larger payments than the above.

   d. On demand for his/her work or materials as far as executed and fixed in place, less the retained percentage, at the time the payment is requested, even though the Engineer fails to approve it for any cause not the fault of the Subcontractor.

   e. A just share of any fire insurance money received by him/her, the Contractor, under Article 35 of these *General Conditions.*

2. To make no demand for liquidated damages or penalty for delay in any sum in excess of such amount as may be specified in the subcontract.

3. That no claim for services rendered or materials furnished by the Contractor to the Subcontractor shall be valid unless written notice thereof is given by the Contractor to the Subcontractor during the first ten (10) days of the calendar month following that in which the claim was originated.

4. To give the Subcontractor an opportunity to be present and to submit evidence in any manner involving his/her rights.

5. The Contractor and the Subcontractor agree that nothing in this Article shall create any obligation on the part of the County to pay to or to see to the payment of any sums to any Subcontractor.

Article 29 Interlocking Contracts

The attention of the Contractor and all Subcontractors is specifically called to the necessity of reading the Specifications covering items of the work which connect with or are dependent upon the work specified under each heading, and each Contractor executing the work called for there under shall be responsible for arranging for proper provision for connecting and coordinating his/her work with such other items.

Article 30 Advertising Signs

A. The Contractor will furnish, erect and maintain a project sign for the duration of the project. The sign shall be placed on the site where and as directed by the Engineer. The sign shall be fastened to three posts spaced 4' apart. The posts shall be 4" x4", seven feet above ground and three feet below ground.

B. The project sign is shown on page GC-27 in this book.

VII. LAWS, PERMITS, LICENSES, INSURANCE, AND BONDS

Article 31 Laws, Permits and Regulations

A. Permit and Service Connections:

1. **BUILDING PERMIT** - The County will obtain the building permit at no cost to the Contractor.

2. **PERMANENT WATER SERVICE** - The County will apply for the water service and pay all related charges; i.e., water meter, water systems connection charge, water distribution charge and sewer systems connection charge. Total installation of the permanent water service is part of this Contract. Water service shall be installed by a County Prequalified Utility Contractor.

3. **PLUMBING PERMIT** - The Contractor shall apply for the Permit; however, the County will pay all related charges and fees.

4. **PERMANENT ELECTRIC SERVICE** - The Contractor shall apply for and pay for the electrical permit. The County shall obtain BGE permanent gas and electric service to the site at no cost to the Contractor.

   The Contractor shall coordinate the installation of permanent gas and electric service with Baltimore Gas & Electric

Company. Both the gas and electric services shall be activated at the same time under one account number showing Baltimore County as owner. The Contractor shall be responsible for payment of consumption charges for the use of gas and electric energy obtained through the permanent service until the building is accepted by the County or until agreed upon by the County in direct coordination with the Building Services Division of Baltimore County. Charges from BGE for removal of existing electric service will be paid by the County.

5. **PERMANENT TELEPHONE SERVICE** - The County shall pay for the telephone service and systems to and in the building. The Contractor is responsible for supplying and installing all conduit, cables and junction boxes as shown on the drawings or called out in the Specifications.

6. **CABLE** - The County shall pay for any cable television service into the building. The contractor is responsible for supplying and installing the remaining work as shown on the drawings and called out in the Specifications.

7. **TEMPORARY SERVICES** -All temporary services, such as water, electric, telephone, etc., shall be the Contractor's entire responsibility. (Also see Article 46.)

8. **MISCELLANEOUS PERMITS** - The Contractor shall procure any and all necessary permits not previously mentioned and pay any and all related charges and fees required and incidental to the due and lawful prosecution of the work.

B. The Contractor shall give all notices and comply with all State and Federal laws, ordinances, rules and regulations bearing on the conduct of the work as drawn and specified. If the Contractor observes that the Drawing and Contract Specifications are at variance therewith, he/she shall promptly notify the Engineer, in writing, and any necessary changes shall be adjusted as provided in the Contract for changes in the work. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to the Engineer, he/she shall bear all costs arising there from.

Article 32 Compensation, Liability, and Property Damage Insurance

(See Insurance Provision in Part VI of this Contract.)

Article 33 Builder's Risk Insurance

A. The Contractor shall, at his/her own cost, insure the work and keep it insured at all times during the period of construction, and until final acceptance of it by the County, against loss or damage covered by

an "All Risk" Builders Risk type of policy. The amount of insurance shall be the 100% estimated replacement cost of the work.

B. The policies shall be made payable to the County and the Contractor, as their interest may appear, and the policies shall be left in the possession of the Engineer, prior to the start of construction.

Article 34 Guaranty Bonds

A. Prior to signing of the Contract, the Contractor will be required to furnish bond covering the faithful performance of the Contract and the payment of all obligations arising there under, in such form as the County may prescribe with such sureties as the County may approve. The premiums shall be paid by the Contractor.

B. The Bond to be in the amount of the total Contract price.

C. At the direction of the Office of Budget and Finance, Property Management, the Contractor may be required to increase the above bond. Such addition will be paid for by the County in the amount of actual cost to the Contractor.

Article 35 Damages

A. If either party to this Contract should suffer damages in any manner because of the wrongful act or neglect of the other party or of anyone employed by him/her, then reimbursement shall be made by the other party for such damage.

B. Claims under this clause shall be made in writing to the party liable within a reasonable time at the first observance of such damage and not later than the time of final payment, except as expressly stipulated otherwise in the case of faulty work or materials, and shall be adjusted by agreement.

C. Should the Contractor cause damage to any separate contractor on the work, the Contractor agrees, upon due notice, to settle with such contractor by agreement or refer the matter to the Office of Budget and Finance, Property Management, who will render a decision after hearing all evidence in the matter. The Contractor shall pay or satisfy such decision.

VIII. INSPECTION AND SURVEYS

Article 36 Inspection

A. If the Construction Specifications, the Engineer's instructions, laws, ordinances, or any public authority require any work to be specially tested or approved, the Contractor shall give the Engineer timely notice of its readiness for inspection, and if the inspection is by another authority, the date fixed for such inspection. Inspections by

the Engineer shall be made promptly, and where practicable, at the source of supply. Any work covered without approval of the Engineer must, if required, be uncovered for examination at the Contractor's expense.

B. If initial tests and/or inspections show substandard products, materials, workmanship, etc. and the Contractor elects, with the Engineer's approval, to perform additional tests and/or inspections to prove the acceptability of the substandard products, materials, workmanship etc., he/she shall perform same at his/her expense.

Article 37 Surveys

A. The General Contractor shall, at his/her own expense, employ a registered surveyor to provide Elevation Bench Mark, and locate corners of the building and the limits of contract.

B. The General Contractor shall, at his/her own expense, employ a competent field engineer, to give the lines and levels for the building, sidewalks and footings, etc. The Contractor will be responsible for all lines and levels and will guarantee all lines and levels as are shown on drawings.

Article 38 Unauthorized Work

Work done without lines and grades being established, work done beyond the lines and grades shown on the Plans or as established, except as herein provided, or any extra work done without written authority will be considered as unauthorized and at the expense of the Contractor and will not be measured by the Engineer, or paid for by the County. Work so done may be ordered by the Engineer to be removed and replaced at the Contractor's expense.

IX. CONSTRUCTION

Article 39 Construction Schedule

The Contractor shall hold bi-weekly "progress meetings" at the site, at a time suitable to the Engineer, at which the progress of the work shall be reported upon in detail with reference to schedules. Each interested subcontractor shall be required to have present a competent representative to report the condition of his/her branch of the work and to receive instructions. Minutes of these "progress meetings" shall be taken by the Contractor who shall type them for distribution to members of the conference, the Office of Budget and Finance, Property Management, and other interested persons. These minutes shall be received by all parties prior to the next scheduled "progress meeting."

Article 40 Protection of Work and Property

A. All trees along the way of access shall be boxed, also all trees surrounding the building which are liable to injury by the moving, storing and working up of materials. No permanent tree shall be used for attachment of any ropes or derricks. Every public way, catch basin, conduit, tree, fence or things injured in carrying out this Contract, shall be replaced and put in good condition, unless the same shall be permanently done away with by order of the Engineer.

B. The Contractor shall erect and properly maintain at all times as required by the conditions and progress of the work, all necessary safeguards for the protection of workers and the public and shall post danger signs warning against the hazards created by such features of construction as protruding nails, hod hoists, well holes, elevator hatchways, scaffolding, window openings, stairways and falling material.

C. In an emergency affecting the safety of life, or of the work, or of the adjoining property, the contractor, without special instruction or authorization is hereby permitted to act, at his/her discretion, to prevent such threatened loss or injury, and he/she shall so act, without appeal, if so instructed or authorized. Any compensation claimed by the Contractor on account of emergency work shall be determined as outlined in Article 11.

Article 41 Shoring, Bracing and Sheeting

A. The Contractor shall do all necessary shoring, bracing and sheeting required, or as directed by the Engineer, to carryout the work, install the foundations and other building construction, to protect the street, sidewalks and all adjoining buildings and property. He/she shall thoroughly brace and protect all earth banks sides of pits, trenches, and other excavations to prevent danger to persons or structures, and to prevent injurious cavings or erosion of any sort. Shoring and sheeting shall be removed after, or as, the walls are built and properly set.

B. Full responsibility for both the design (by an Engineer licensed in Maryland) and the execution of all shoring, bracing, and sheeting work shall rest upon the contractor. While the Engineer shall be fully advised of all details for such work before the work itself is executed, this shall not in any way relieve the Contractor for full responsibility for all damage or expense arising from faulty installation of the said work of shoring, bracing, or sheeting.

Article 42 Tests

A. Soils testing shall be performed by an independent testing firm arranged and paid for by the County.

B. Materials testing shall be performed by an independent testing firm, paid for by the Contractor, which has previously been approved by the County and Architect/Engineer. Certified copies of all such test reports shall be submitted to the Engineer for approval.

Article 43 Cleaning Up

A. The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish caused by his/her employees or work, and at the completion of the work, shall remove all his/her rubbish from and about the project site, and all his/her tools, scaffolding and surplus material.

   In case of dispute, the County may remove the rubbish and charge the cost to the several contractors as the Engineer shall determine to be just.

B. All debris shall be kept sprinkled to reduce dust and shall be promptly removed from the building, and no combustible materials shall be stored against perimeter walls.

C. The Contractor shall clean entirely the building as it is completed, wash all windows, scrub all floors at least once, and leave all floors free from spots and blemishes. The interior of the building and the project area shall be left "broom clean," or its equivalent.

Article 44 As-Built Drawings

The Contractor shall, as the project progresses, neatly record on a set of white prints any changes and all revisions to the work wherever they shall differ from the Contract Drawings. Upon completion of the work, the · Contractor shall turn over to the Architect this set of prints.

Article 45 Drainage and Pumping

The Contractor shall remove all water, including rain water, encountered during the entire progress of the work, using pumps, drains or other methods approved by the Engineer. Excavations and the project site shall be kept free from water until all backfilling is completed. The water shall be discharged to catch basins, or other drainage points as directed by the Engineer.

Article 46 Temporary Water, Electric and Other Services

A. The Contractor shall arrange for and pay for the installation of temporary connection to the County's water mains, including all incidental fees and expenses for water supply during construction of the project, and shall pay for all water used. Wasting of County water will not be permitted.

B. The Contractor shall arrange for and pay for temporary electric light and power service required during construction of the project, and shall pay for all electricity used. Gasoline or other torches for lighting will not be permitted.

C. The Contractor shall provide and pay for any other temporary services which may be required for the satisfactory completion of the project.

D. The Contractor shall provide, at his/her own expense, all cold weather protection, temporary heat and fuel as necessary to carry on the work expeditiously during inclement weather, to protect work and materials against injury from dampness and cold, to dry out the building and provide suitable working conditions. Refer to other sections for temperatures required for work under the various trades

The methods of heating and type of fuel and equipment used shall be subject to approval by Engineer.

With special permission, in writing, permanent heating system may be used to dry out building and provide suitable working conditions in all or various parts thereof as soon as practicable. If used, Contractor shall be responsible for use of permanent heating system for purpose described and all costs of fuel, attendance, etc. in connection therewith shall be borne by him/her. Such use shall not relieve Contractor of his/her responsibility to turn over system to Owner in perfect condition on completion of project, including the removal of all dust of construction from air handling units, etc., the replacing of all filters, etc., nor shall it shorten stipulated guarantee period which will commence upon the date of final acceptance of the work.

Article 47 Connecting to Existing Utilities

The Contractor shall, at his/her own cost and expense and as part of this work under the Contract, furnish all labor, materials, tools, and appliances, and do all work required for making connections to existing storm drains, sanitary sewer, water, gas and electric service connections, as shown on drawings, and the cost of making such connections shall be included in his/her bid.

Article 48 Existing Utilities Shown on Plans

Water mains, gas mains, storm drains, sanitary sewers, and other utilities are shown on the Plans, in accordance with the best information available, for the information of the Contractor. The County assumes no responsibility for accuracy or completeness of the information shown. Existing mains and services shall be carefully protected and any damage to them caused by the work shall be immediately repaired to the satisfaction of the Engineer by the Contractor at his own expense, using materials of the quality and kinds damaged.

X. MISCELLANEOUS ADDENDA

Article 49 Holidays

The word "holidays" used in these Contract Documents shall be taken to mean the below listed holidays, which in Baltimore County, occur as shown below:

January 1	New Year's Day
3rd Monday in January	Martin Luther King's Birthday
3rd Monday in February	President's Day
4th Monday in May	Memorial Day
June 19	Juneteenth Independence
July 4	Independence Day
1st Monday in September	Labor Day
2nd Monday in October	Indigenous Peoples' Day
November 11	Veteran's Day
4th Thursday in November	Thanksgiving Day
December 25	Christmas
All Days of General Elections	

If any holiday occurs on Sunday, the following Monday shall be considered a holiday. If the holiday occurs on Saturday, the Friday immediately preceding shall be considered a holiday.

Article 50 Buy American Steel Act

The State of Maryland has approved House Bill No. 1659 to "Buy American Steel" for all Public Works projects in the State of Maryland, effective July 1, 1978. Compliance with Article 20.17 Metal Pipe (Page 100) and Article 20.18 Metal for Structures (Page 102) in the *S.H.A. Specifications for Materials, Highways, Bridges and Incidental Structures* dated March 1968 will satisfy this condition. Also see *Baltimore County's Standard Specifications for Construction and Materials* Section GP 7.28.

Article 51 Guarantee

A. The Contractor guarantees all work against faulty or imperfect materials, against all imperfect or careless and/or unskilled workmanship, against all leaks and against all mechanical and electrical failure of equipment for a period of two (2) years from the date of acceptance of the project by the County. See other Sections of this Specification for other guarantees.

B. The Contractor shall remove, replace or re-execute, without cost to the Owner, any work found to be imperfect during the guarantee period.

Article 52 Offices and Telephones

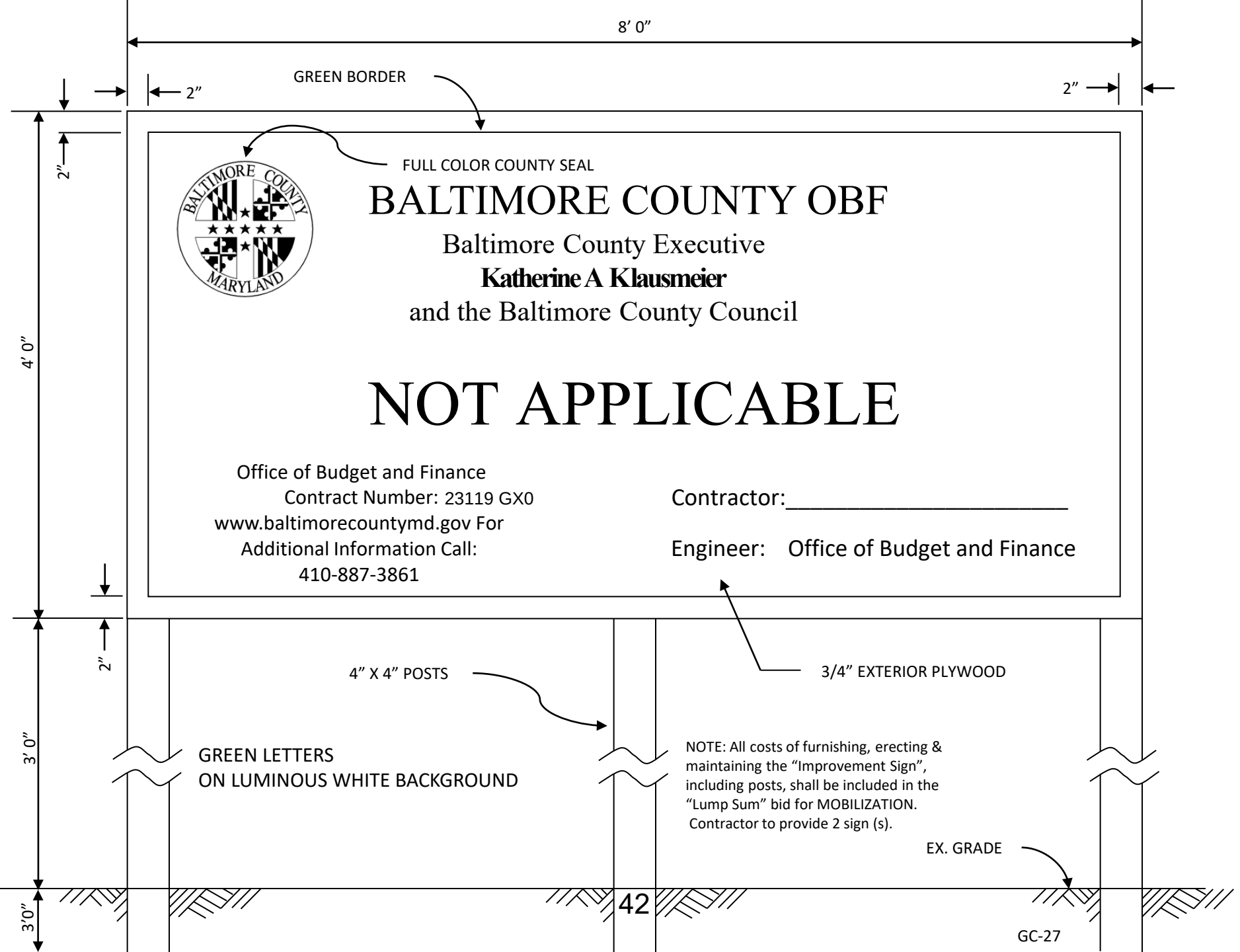
A. The Contractor shall erect and maintain upon the project site, and where directed by the Engineer, suitable offices for his/her own use and that of the Engineer.

B. A room of adequate size shall be provided and maintained in the Contractor's office to be used for "Progress Meetings," which frequently involve fifteen (15 or more persons). This space shall be so arranged that they can be held without interference with or from the other office or supervisory work. The room shall be 300 sq. ft. minimum and 10 ft. minimum width.

These offices shall be provided with adequate heating and lighting, all at the expense of the Contractor. In addition to the above requirements, air-conditioning will be required, the cost of which is to be included in the lump sum bid price. The system must be capable of maintaining a temperature of 80 degrees F dry bulb and approximately 50% relative humidity in the conditioned area when outside temperatures are 95 degrees F dry bulb and 78 degrees F wet bulb.

C. The Engineer's office shall meet or exceed all requirements for a Type 1 office in accordance with *Baltimore County's Standard Specifications for Construction and Materials,* Section 103 Engineer's Office.

The Contractor shall provide telephone and FAX service in the Office of the Engineer. The Contractor shall pay all costs of installation and all charges for local and Baltimore City calls, but will not be expected to pay for long distance calls made from the Engineer's Office.


8’ 0”
GREEN BORDER
2”
2”
2”
FULL COLOR COUNTY SEAL
BALTIMORE COUNTY OBF
Baltimore County Executive
Katherine A Klausmeier
and the Baltimore County Council
NOT APPLICABLE
Office of Budget and Finance
Contract Number: 23119 GX0
www.baltimorecountymd.gov For
Additional Information Call:
410-887-3861
Contractor:_____
Engineer: Office of Budget and Finance
4’ 0”
2”
4” X 4” POSTS
3/4” EXTERIOR PLYWOOD
3’ 0”
GREEN LETTERS
ON LUMINOUS WHITE BACKGROUND
NOTE: All costs of furnishing, erecting & maintaining the “Improvement Sign”, including posts, shall be included in the “Lump Sum” bid for MOBILIZATION.
Contractor to provide 2 sign (s).
EX. GRADE
3’0”
42
GC-27

PROJECT MANUAL

FOR THE

WILKENS POLICE PRECINCT – 01
NEW BUILDING DESIGN

BALTIMORE COUNTY, MARYLAND

901 Walker Ave,

Catonsville, Maryland 21228

Contract Number – 24111 PPO

Job Order Number - 300200006

BALTIMORE COUNTY OFFICE OF BUDGET & FINANCE – PROPERTY MANAGEMENT

100% CONSTRUCTION DOCUMENTS
June 19, 2025

A/E Design Team

Architect: **Murphy & Dittenhafer Architects**, Baltimore, MD.

Mechanical/Plumbing/Electrical Engineers: **BOWMAN,** Baltimore, MD.

Structural Engineers: **Columbia Engineering,** Columbia, MD.

Civil Engineer: **MK Consulting Engineers,** Baltimore, MD.

Landscape Architect: **Mahan Rykiel,** Baltimore, MD.

IT / Telecom / Data/ Security & Acoustics: **Convergent Technologies Design Group, Inc**, Baltimore, MD.

LEED Design: **Sustainable Design Consulting, LLC,** Richmond, VA.

Fire Protection: **Setty & Associates,** Baltimore, MD.

Professional Cost Estimator: **CostCon Construction Services**, Crownsville, MD.

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WILKENS POLICE PRECINCT – 01
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A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Related Requirements:

1. Division 01 Section "Alternates" for add alternates.
2. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
3. Division 02 Section “Structure Demolition” for salvage list.

B. Section Includes:

1. Project information
2. Work Covered by Contract Documents
3. Phased construction.
4. Work Performed by Owner
5. Owner-Furnished/Contractor-Installed (OFCI) Products
6. Owner-Furnished/Owner-Installed (OFOI) Products
7. Contractor’s Use of Site and Premises
8. Coordination with Occupants
9. Work Restrictions
10. Specifications and drawings conventions

1.3 DEFINITIONS

A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.4 PROJECT INFORMATION

A. Project Identification: Wilkens Police Precinct - 01
New Building Design

B. Project Location: 901 Walker Avenue
Catonsville, Maryland 21228

C. Project Number: Contract Number: 24111 PPO
Job Order Number: 300200006

D. Owner: Baltimore County Property Management, Office of Budget & Finance
   1. Owner's Representatives:
      a. Chuck Jones, Property Management Specialist, Baltimore County Property Management; Ph: 410-887-7206.

E. Architect: Murphy & Dittenhafer Architects, Inc. 805 North Charles Street; Baltimore, Maryland 21201; Ph: 410-625-4823

F. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:

   1. Structural Engineer: Columbia Engineering, 6210 Old Dobbin Lane #150, Columbia, MD; Ph. 410.992.9970
   2. Civil Engineering: MK Consulting Engineers, The Star Building, 1801 Porter Street, Suite 401, Baltimore, MD 21230; Ph. 667.309.6193
   3. MEP Engineer: Bowman Engineering, 300 East Joppa Road, Suite 501, Towson, MD 21286; Ph. 410.494.1111
   4. Low Voltage Design: Convergent Technologies Group; 6501 York Road; Baltimore, Maryland 21212; Ph. 410-532-2395
   5. Fire Protection: Setty Engineering, 575 South Charles Street, Suite 404, Baltimore, MD 21201; Ph. 667.309.3494
   6. Landscape Architecture: Mahan Rykiel Associates, Inc. 3300 Clipper Mill Road, Baltimore, MD 21211; Ph. 410.235.6001
   7. LEED Consultant: Sustainable Design Consulting, LLC, 1432 K Street NW, 3rd Floor, Washington, DC 20005; Ph. 202.667.1620

1.5 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

   1. The work includes the construction of a new two-story police precinct building of approximately 33,800 GSF on the existing Wilkens Police site, located at 901 Walker Avenue. Four (4) freestanding building structures currently exist on the 3-acre site. The one-story annex building, and two adjacent shed structures located on the SW region of the site will be demolished first to make room for the new building. The existing precinct building, built in the early 1960's, will *remain operational* during construction and be demolished after completion of the new building and relocation of the police. Site work will be finalized after the existing precinct building is demolished.

      Site work will disturb 2.84 acres of the 3-acre site. Work includes widening the main entrance drive, removal of the existing gasoline underground storage tank and fuel pump per the Phase I ESA, regrading and construction of site retaining walls, construction of stormwater management facilities, construction of a new fueling station, and security fencing for the secure parking lot.

      The new precinct building will be all electric and include photovoltaic panels on the roof. The building will have a backup diesel-powered generator located outside; the generator is sized to power the building for a 96-hour duration.

      Fiber optic line relocation along Walker Avenue will be performed by others prior to the start of the precinct construction; site work shall be coordinated with the new location of the fiber lines.

B. Type of Contract:

1. Project will be constructed under a General Construction Contract.

C. Removal and disposal of materials:

1. Non-hazardous materials shall be removed in accordance with Specification Section 01 74 19 – Construction and Demolition Waste Management and Disposal.
2. The existing 1960s precinct building contains known hazardous materials. Refer to the Hazardous Materials Reports attached in the Appendix and spec section 02 81 00 – Transportation and Disposal of Hazardous Materials. The Contractor is responsible for coordinating the proper removal of all hazardous materials during demolition of the existing building. All hazardous materials abatement packaging, transport, and disposal must be performed in strict compliance with all applicable local, state, and federal regulations, latest edition. The Contractor must maintain all licenses and certifications, in accordance with these regulations, which must be current for the entire term of this agreement.

D. LEED Certification:

1. LEED Silver Certification is required.

E. Refer to Bid Documents for other contract requirements.

1.6 PHASED CONSTRUCTION

A. Contractor shall construct the work in phases. Contractor shall provide any means and methods necessary to meet the Operations and Access criteria listed below. The Contractor shall not be limited to a number of phases and those phases as indicated in the drawings and herein are only a suggestion.

1. Phasing Plan Submission: The Contractor shall present a detailed phasing plan prior to the start of construction at the initial meeting for review by the Owner and Design Team. Owner and Design Team will provide verbal comments after the presentation. Within seven (7) days after the initial meeting, Contractor shall submit a formal written phasing plan, which incorporates the Owner and Design Team comments from the initial meeting, for approval by the Owner and Design Team.
   a. Contractor shall not commence any construction activities until written approval of the submitted Phasing Plan has been provided by the Owner. The Contract time shall not be increased due a delay in Phasing Plan approval because of the Contractor not complying with Owner or Design Team direction on Phasing Plan revisions.
   b. Deviations from the approved Phasing Plan shall not occur without written approval by the Owner. Contractor shall propose revisions to the Phasing Plan to the Owner at any time. Only once revisions have been approved shall they occur.

2. Continuous Operations: The Wilkens Police precinct shall be continuously able to operate and be provided functional power and network operations, MEP systems and Fire Alarm & Sprinkler systems. The existing generator shall be relocated to maintain backup power to the existing building through the duration of Phase 1. The Contractor shall provide notice and grant right of entry provided to Baltimore County Property Management's (BCPM) Information Technology staff to access the main IT room for the duration of the project. Demolition or work in the areas of the existing precinct building shall occur only after U&O

is granted for the new precinct building. Any temporary outages related to connection of new utilities shall be carefully coordinated with police operations so as to limit disruptions.

a. References: See Civil sheets for Phased Demolition Plans and Architectural Phasing sheet for diagrammatic phasing of demolition and new building construction. The Contractor is responsible for following all phasing criteria and is responsible for the detail, sequencing, permitting and inspections in all aspects of Phasing.
b. Utilities: All utilities are required for Police and Information Technology operations. Reference Civil, MEP, & TA drawings and specifications.
    1) The Police are to be notified of work that impacts underground utilities or requires an outage of service. The Contractor will need to provide 48 business hours' notice to the Police via BCPM for scheduled work that impacts daily operations.
c. Temporary parking: refer to the Civil Demolition Plans for temporary parking for police vehicles on site during construction.
d. Life Safety: The Contractor shall be responsible for coordination, permitting and inspection of all aspects of Life Safety and all other inspections required by the (AHJ) Authority Having Jurisdiction per the Contractor's phasing plans. Protect access and egress for all Police staff and BCPM IT staff in areas near the work. Pedestrian pathways shall be required. The Contractor shall provide a safety procedures plan.

3. Phasing Requirements and suggested phases:

Phase 1:

- Remove existing gasoline underground storage tank and fuel pump. The ESA identifies that the soils that were contaminated were remediated.
- Widen entrance drive. This is to provide construction entrance separate from precinct and public access.
- Demolish Annex and all other structures besides the precinct buildings that will remain in phase 1.
- Relocate existing generator outside of the phase 1 work area, south of the Precinct building and reconnect to continue to operate the precinct during phase 1.
- Rework utilities and grades per civil drawings. Construct new building, equipment, furnish and commission, achieve Use and Occupancy, and relocate staff into new building.

Phase 2:

- Flip access and construction fencing for new work area.
- Demolish the now abandoned precinct building. Any hazardous materials shall be properly abated and disposed of.
- Grade work and provide utility connections and per civil drawings and complete public parking area paving, fencing, landscaping, site furnishings and memorial garden.

4. Referenced Work: Fiber optic cable relocation shall be completed by others prior to this site work and the GC shall coordinate the connection with the relocated lines.

5. Substantial Completion:

    1) The first phase of construction will be considered completed once all Police operations resume in new precinct building and occupancy U&O has been granted. The Contractor shall be responsible for any comments and provisions required for all sign off or certificates from AHJ and their inspectors.

Contractor shall submit their proposed phasing and egress plans for AHJ's approval. Subsequent phased work may begin after the Notice to Proceed.

2) Later phases will be considered completed once all building and site areas meet substantial completion.

6. Building's Occupants Move-out / Move-in: Building Occupant Move-out and move-in period shall be up to 30) thirty calendar days from scheduled Use and Occupancy granted for the new building. Once the occupants have moved out, the Contractor shall pack salvage items to be packed and relocated into new building. Once the occupants and salvage items have been relocated to the new building then demolition of the exiting facility may begin.

B. Before commencing Work of each phase, submit an updated copy of Contractor's construction schedule, showing the sequence, commencement, and completion dates, and move-out and -in dates of Owner's personnel for all phases of the Work.

1.7 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:

1. Review and confirm with the Architect as needed Product Data, Shop Drawings, and Samples.
2. Provide for delivery of Owner-furnished products to Project site.
3. Upon delivery, inspect, with Contractor present, delivered items.

a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.

4. Obtain manufacturer's inspections, service, and warranties.
5. Inform Contractor of earliest available delivery date for Owner-furnished products.

B. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
3. Receive, unload, handle, store, protect, and install Owner-furnished products.
4. Make building services connections for Owner-furnished products.
5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
6. Repair or replace Owner-furnished products damaged following receipt.

C. Owner-Furnished/Contractor-Installed (OFCI) Products:

1. Audio and Video Equipment as indicated on the Drawings.

2. Salvage List:
   a. All gun unloading stations / bullet traps are to be packed and transported into new facility from the existing facility by the Contractor.

b. A gun safe is to be packed and transported into new facility from the existing facility by the Contractor.
c. Memorial Stones / Plaques from the memorial garden are to be packed by Contractor and provided to Owner for storage.
d. Fitness equipment, including (1) treadmill, (1) stair climber, (1) universal machine, (1) leg press, and all plates are to be packaged and relocated off site by Contractor.

1.8 OWNER-FURNISHED/OWNER-INSTALLED (OFOI) PRODUCTS

A. The Owner will furnish and install products indicated as Not in Contract (NIC). All other fixtures & equipment documented in the drawings shall be provided by GC.

B. Owner-Furnished/Owner-Installed (OFOI) Products:

1. FF&E, new and existing to be reused furnishings will be stored off site and installed after U&O has been granted to completed phased areas.

1.9 SITE AND PREMISES

A. Unrestricted Use of Site: Contractor shall make full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.10 COORDINATION WITH OCCUPANTS

A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.11 WORK RESTRICTIONS – AS NOTED IN BID DOCUMENTS

1.12 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 21 00 - ALLOWANCES

PART I - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:

1. Lump-sum allowances.
2. Unit-cost allowances.
3. Quantity allowances.
4. Contingency allowances.

C. Related Requirements:

1. Section 012200 "Unit Prices" for procedures for using unit prices, including adjustment of quantity allowances when applicable.

2. Section 013300 "Submittal Procedures.

1.2 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

1.3 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.4 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 LUMP-SUM ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes**,** freight**,** and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. See Schedule of Allowances.

1.6 UNIT-COST ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. See Schedule of Allowances.

1.7 QUANTITY ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. See Schedule of Allowances.

1.8 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Lump-Sum Allowance: Include the sum of $50,000.00 for Memorial Garden.

1. This allowance includes material, receiving, handling, and installation costs, and Contractor overhead and profit.

END OF SECTION 012100

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

B. Related Requirements:

1. Section 012100 “Allowances” for procedures related to providing an allowance for hazardous materials noted in the Hazardous Material Survey Reports.
2. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.3 DEFINITIONS

A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit, unless otherwise indicated.

B. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

C. List of Unit Prices: A schedule of unit prices is included in the Bid Form. Specification Sections referenced in the schedule contain requirements for materials described under each unit price. Unit prices are fixed.

1.5 SCHEDULE OF UNIT PRICES

A. Unit Price No. 1: Provide unit cost per cubic yard (cu. yd.) of Class III soil excavation and disposal off-site and replacement with select backfill material from off-site, as specified in Section 312000 "Earth Moving."

1. Fixed unit price of $130/cubic yard per Baltimore County Commodity Code: Utility 800020.

B. Unit Price No. 2: Provide unit cost per cubic yard (cu. yd.) of soil excavation and disposal offsite and use of lean concrete in lieu of select backfill as specified in Section 312000 3.9 Unauthorized Excavation in "Earth Moving".

1. Provide unit price.

C. Unit Price No. 3: Provide unit cost per cubic yard (cu. yd.) of Rock excavation and disposal off-site, as specified in Section 312000 "Earth Moving."

1. Provide unit price for 100 cubic yards (cu. yd.)

D. Provide Unit Prices related to removal of Hazardous Materials per the table under PART 4; refer to Hazardous Materials Survey Reports in Appendices C and D.

1. The Unit Prices table in PART 4, in conjunction with the Hazardous Materials Survey Reports in Appendices C and D, is to be used to determine an allowance for known hazardous materials abatement. Refer to spec Section 01 21 00 – Allowances.
2. The Unit Prices provided are to be utilized, where applicable, for additional hazardous materials found above and beyond what is listed within the Hazardous Materials Survey Reports in Appendices C and D.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

PART 4 - HAZMAT MATERIALS UNIT PRICE SCHEDULE

A. To be included with Bid Submission.

Item	Description	Unit	Rate
1.0 Asbestos			
1.1	Tile and Mastic	SF	
1.2	Pipe Insulation	LF	
1.3	Door & Window Caulk	LF	
2.0 Lead Based Paint Evaluation			
2.1	Per Room	SF	
3.0 Dust-Lead Hazards			
3.1	Per Room	SF	
4.0 Hazardous Materials Survey			
4.1	Fluorescent Light Fixtures (Ballasts)	EA	
4.2	4’ Fluorescent Light Tubes	EA	
4.3	Exit Signs (Batteries)	EA	
4.4	Fire Extinguishers	EA	
4.5	Mercury Switch	EA	
5.0 PCB			
5.1	Door & Window Caulk	EA	
6.0 Additional Items – Not Inspected during Hazardous Materials Survey			
6.1	Roofing Materials	SF	
6.2	Fire Doors	EA	
6.3	Ceiling Tiles	SF	
7.0 Additional Hazardous Materials			
7.1	Car Batteries	EA	
7.2	Refrigerants	EA	
7.3	Fire Extinguishers	EA	
7.4	Antifreeze, Cleaners, Chemicals, Oil, Gasoline	EA	
7.5	Tires	EA	
15.0	Labor Rate for Certified Asbestos Worker (Straight time)	HR	
16.0	Labor Rate for Certified Asbestos Worker (Over time)	HR	

END OF SECTION

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Add Alternate No. 1: The Amount to be added to the total contract sum in connection with increasing the base bid level 3 ballistic ratings at the first-floor exterior storefront system and glazing to level 5 ballistic rating, as shown on the architectural drawings.

B Add Alternate No. 2: The Amount to be added to the total contract sum in connection with providing level 5 ballistic rated storefront system and glazing to all second floor Type W-1 windows in lieu of the GL-1 glazing.

C. Add Alternate No. 3: The Amount to be added to the total contract sum in connection with adding a single duplex receptacle to each of the welded metal personal storage lockers in the GN Locker Room (228), Women's Locker Room (229), and Men's Locker Room (230) and connecting them via the welded-metal locker manufacturer's plug-to-plug connector harness.

D. Add Alternate No. 4: The Amount to be added to the total contract sum in connection with providing a 20-foot wide by 8-foot tall bi-fold security gate, PDXT SpeedGate by Wallace Perimeter with automatic operator in lieu of DoorKing swing gate.

E. Add Alternate No. 5: The Amount to be added to the total contract sum in connection with providing an Adult Changing Station in Restroom 126. Basis of design to be Koala Kare model KB3000-AHL, or approved equal. Wall supports and electrical power shall be provided in the base bid.

END OF SECTION 01 23 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions made after award of the Contract.

1.3 DEFINITIONS

A. Substitutions: Products considered to be able to perform the same function but not necessarily have the same design, arrangement, details, utility requirements and/or dimensions. Changes in products, materials, and equipment required by the Contract Documents proposed by the Contractor after award of the Contract are considered to be requests for substitutions. The following are not considered to be requests for substitutions:

1. Revisions to the Contract Documents requested by the Owner or Architect.
2. Specified options of products or “approved equals” as permitted and included in the Contract Documents.
3. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

B. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.

C. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. General: No substitution requests will be considered from manufacturer’s representatives or product vendors unless submitted through the Contractor. No substitution requests will be considered during the bid period. Bids shall be based on products from one of the manufacturers specified or an “or equal” product.

B. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use form that is acceptable to Architect.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within (7) days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within (15) days of receipt of request, or (8) days of receipt of additional information or documentation, whichever is later.

a. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than (15) days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within (60) days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Architect.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
b. Requested substitution does not require extensive revisions to the Contract Documents.
c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
d. Substitution request is fully documented and properly submitted.
e. Requested substitution will not adversely affect Contractor's construction schedule.
f. Requested substitution has received necessary approvals of authorities having jurisdiction.
g. Requested substitution is compatible with other portions of the Work.
h. Requested substitution has been coordinated with other portions of the Work.
i. Requested substitution provides specified warranty.
j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Division 01 Section "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
2. Division 01 Section "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: The Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by the Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within (14**)** days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include costs of labor and supervision directly attributable to the change.
    d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and

finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to the Owner.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, the Contractor will issue a Change Order for signatures of Owner and Contractor.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: The Architect may issue through Owner a Construction Change Directive. Construction Change Directive instructs the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. The Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
2. Submit the schedule of values to Architect at earliest possible date, but no later than (5) days after Notice to Proceed.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

    a. Project name and location.
    b. Owner's name.
    c. Owner's Project number.
    d. Name of Architect.
    e. Architect's Project number.
    f. Contractor's name and address.
    g. Date of submittal.

2. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:

    a. Related Specification Section or division.

b. Description of the Work.
c. Name of subcontractor.
d. Name of manufacturer or fabricator.
e. Name of supplier.
f. Change Orders (numbers) that affect value.
g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
   1) Labor.
   2) Materials.
   3) Equipment.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Principal subcontract amounts should be broken down into multiple Items. Each Item should be complete including its total cost and proportionate share of general and administrative overhead and profit. All dollar amounts should be rounded to the nearest whole dollar. The total of all the Items should equal the Contract price.

   a. The maximum value of any activity is $25,000.

4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

   a. Differentiate between items stored on-site and items stored off-site.

5. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
6. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling (5) percent of the Contract Sum and subcontract amount.
7. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.
8. Submittal for preliminary and monthly progress submittals for Building Product Calculator (BPC), Construction and Demolition Waste Management Plan and Indoor Air Quality Plan.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.

B. Payment Application Times: Submit Application for Payment to the Owner by the 25th of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

   1. Submit draft copy of Application for Payment (7) days prior to due date for review by Architect.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

1. Other Application for Payment forms proposed by the Contractor may be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. The Owner will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit (3) signed and notarized original copies of each Application for Payment to the Owner by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Products list (preliminary if not final).
5. Sustainable design action plans, including preliminary project materials cost data.
6. Submittal schedule (preliminary if not final).
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Copies of building permits.
10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
11. Initial progress report.
12. Report of preconstruction conference.

I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

    a. Complete administrative actions, submittals, and Work preceding this application, as described in Division 01 Section "Closeout Procedures."

2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
3. Administrative actions and/or submittals that shall precede or coincide with this application include:

    a. Occupancy permits and similar approvals.
    b. Warranties (guarantees) and maintenance agreements.
    c. Test/adjust/balance records.
    d. Maintenance instructions.
    e. Startup performance reports.
    f. Changeover information related to Owner's occupancy, use, operation, and maintenance.
    g. Final cleaning.
    h. Application for reduction of retainage and consent of surety.
    i. Advice on shifting insurance coverages.
    j. List of incomplete Work, recognized as exceptions to Architect's Certificate of Substantial Completion.

J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Certification of completion of final punch list items.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.

5. AIA Document G706.
6. AIA Document G706A.
7. AIA Document G707.
8. Evidence that claims have been settled.
9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
10. Final liquidated damages settlement statement.
11. Proof that taxes, fees, and similar obligations are paid.
12. Waivers and releases.
13. Completion of LEED Online documentation.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Web-based Project management software package.
6. Project meetings.

B. Related Requirements:

1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.
4. Division 01 Section "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in temporary field office and in web-based Project software directory. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is

required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

    a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    b. Coordinate the addition of trade-specific information to coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
    c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    f. Indicate required installation sequences.
    g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling, and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:

    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:

a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:

a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.

C. Coordination Drawing Process: Prepare coordination drawings in the following manner:

1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.

1.7 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.

2. Owner name.
3. Owner's Project number.
4. Name of Architect.
5. Architect's Project number.
6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.
15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: The Contractor’s web-based Project management software will be used for submitting RFI’s.

1. Attachments shall be electronic files in PDF format.

D. Architect's Action: Allow (5) days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Owner in writing within [3] days of receipt of the RFI response.

E. RFI Log: Use software log that is part of web-based Project management software.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within (3) days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Web-Based Project Management Software Package: Contractor may use web-based Project management software for purposes of hosting and managing Project communication and documentation with Architect until Final Completion; however, all communication and documentation with the Owner must be directly via email. The owner will not use the web-based project management software or have any responsibility for it. The proper Owner point of contact will be identified to receive copies of pdfs and emails generated from the software.

1. Web-based Project management software includes the following features:

a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, and other entities involved in Project. Include names of individuals and contact information. Note that the Owner will not utilize the project management software and all submittals to the Owner shall be via email.
b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
c. Document workflow planning, allowing customization of workflow between project entities.
d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
e. Track status of each Project communication in real time, and log time and date when responses are provided.
f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
g. Creating and distributing meeting minutes.
h. Document management for Drawings, Specifications, and coordination drawings, including revision control.
i. Management of construction progress photographs.
j. Mobile device compatibility, including smartphones and tablets.

2. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.

B. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

A. General: Contractor will schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. The Contractor shall equip the job trailer or designated meeting site with the following equipment to support virtual / hybrid meetings.
   a. A 40in television monitor connected to a computer
   b. A laptop computer with high speed internet access and HDMI or equivalent audio and video connection to the television monitor.
   c. WiFi access for attendees as needed
   d. A web camera and speaker / intercom that provides clear visual and audible connection for virtual attendees.

2. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
3. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
4. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within (5) days of the meeting.

B. Preconstruction Conference: Owner will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect.

1. Attendees: Authorized representatives of Owner**,** Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

   a. Responsibilities and personnel assignments.
   b. Tentative construction schedule.
   c. Phasing, if applicable.
   d. Critical work sequencing and long lead items.
   e. Designation of key personnel and their duties.
   f. Lines of communications.
   g. Use of web-based Project software.
   h. Procedures for processing field decisions and Change Orders.
   i. Procedures for RFIs.
   j. Procedures for testing and inspecting.
   k. Procedures for processing Applications for Payment.
   l. Distribution of the Contract Documents.
   m. Submittal procedures.
   n. Sustainable design requirements.
   o. Preparation of Record Documents.
   p. Use of the premises**.**
   q. Work restrictions.
   r. Working hours.
   s. Owner's occupancy requirements.
   t. Responsibility for temporary facilities and controls.
   u. Procedures for moisture and mold control.
   v. Procedures for disruptions and shutdowns.

w. Construction waste management and recycling.
x. Parking availability.
y. Office, work, and storage areas.
z. Equipment deliveries and priorities.
aa. First aid.
bb. Security.
cc. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, and Owner's Commissioning Authority of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Sustainable design requirements.
i. Review of mockups.
j. Possible conflicts.
k. Compatibility requirements.
l. Time schedules.
m. Weather limitations.
n. Manufacturer's written instructions.
o. Warranty requirements.
p. Compatibility of materials.
q. Acceptability of substrates.
r. Temporary facilities and controls.
s. Space and access limitations.
t. Regulations of authorities having jurisdiction.
u. Testing and inspecting requirements.
v. Installation procedures.
w. Coordination with other work.
x. Required performance results.
y. Protection of adjacent work.
z. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Contractor will schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than (90) days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

    a. Preparation of Record Documents.
    b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    c. Procedures for completing and archiving web-based Project software site data files.
    d. Submittal of written warranties.
    e. Requirements for completing sustainable design documentation.
    f. Requirements for preparing operations and maintenance data.
    g. Requirements for delivery of material samples, attic stock, and spare parts.
    h. Requirements for demonstration and training.
    i. Preparation of Contractor's punch list.
    j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    k. Submittal procedures.
    l. Owner's partial occupancy requirements.
    m. Installation of Owner's furniture, fixtures, and equipment.
    n. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Contractor will conduct progress meetings at biweekly intervals.

1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties

involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Status of sustainable design documentation.
5) Deliveries.
6) Off-site fabrication.
7) Access.
8) Site use.
9) Temporary facilities and controls.
10) Progress cleaning.
11) Quality and work standards.
12) Status of correction of deficient items.
13) Field observations.
14) Status of RFIs.
15) Status of Proposal Requests.
16) Pending changes.
17) Status of Change Orders.
18) Pending claims and disputes.
19) Documentation of information for payment requests.
20) LEED requirements and status update.

3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's Construction Schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Unusual event reports.

B. Related Requirements:

1. Division 01 Section "Quality Requirements" for schedule of tests and inspections.
2. Division 01 Section "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.
3. Division 01 Section “Sustainable Design Requirements - LEED” for product documentation per credit requirements.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file.
2. PDF file.

B. Startup construction schedule.

1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
3. Total Float Report: List of activities sorted in ascending order of total float.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at weekly intervals.

H. Material Location Reports: Submit at weekly intervals.

I. Site Condition Reports: Submit at time of discovery of differing conditions.

J. Unusual Event Reports: Submit at time of unusual event.

K. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including phasing work stages area separations and interim milestones.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

B. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting, using CPM scheduling.

1. In-House Option: Owner may waive requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

C. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

D. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Temporary Facilities: Indicate start and completion dates for the following as applicable:

a. Securing of approvals and permits required for performance of the Work.
b. Temporary facilities.
c. Construction of mock-ups, prototypes and samples.
d. Owner interfaces and furnishing of items.
e. Interfaces with Separate Contracts.
f. Regulatory agency approvals.
g. Punch list.

3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.

5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.

6. Commissioning Time: Include no fewer than 15 days for commissioning.

7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
8. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.

E. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Work Restrictions: Show the effect of the following items on the schedule:

a. Coordination with existing construction.
b. Uninterruptible services.
c. Partial occupancy before Substantial Completion.
d. Use-of-premises restrictions.
e. Provisions for future construction.
f. Seasonal variations.
g. Environmental control.

2. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

a. Subcontract awards.
b. Submittals.
c. Purchases.
d. Mockups.
e. Fabrication.
f. Sample testing.
g. Deliveries.
h. Installation.
i. Tests and inspections.
j. Adjusting.
k. Curing.
l. Building flush-out.
m. Startup and placement into final use and operation.
n. Commissioning.

F. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion, and the following interim milestones:

1. Temporary enclosure and space conditioning.

G. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and the Contract Time.

H. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.

2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Final Completion percentage for each activity.

I. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

J. Distribution: Distribute copies of approved schedule to Architect**,** Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.8 STARTUP CONSTRUCTION SCHEDULE

A. Startup Network Diagram: Submit diagram within 30 days of award of contract.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first **90** days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.9 CPM SCHEDULE REQUIREMENTS

A. Prepare network diagrams using AON (activity-on-node) format.

B. CPM Schedule: Prepare Contractor's Construction Schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than 30 days after award of contract.
2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.

C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

    a. Preparation and processing of submittals.
    b. Mobilization and demobilization.
    c. Purchase of materials.
    d. Delivery.
    e. Fabrication.
    f. Utility interruptions.
    g. Installation.
    h. Work by Owner that may affect or be affected by Contractor's activities.
    i. Testing and inspection.
    j. Commissioning.
    k. Punch list and Final Completion.
    l. Activities occurring following Final Completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

    a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, sustainable design documentation, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.

    a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
    b. Total cost assigned to activities shall equal the total Contract Sum.

D. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.

E. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.

6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

G. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.

1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.

    a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.

1.10 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Construction Change Directives received and implemented.

17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 32 00

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Division 01 Section "Project Management and Coordination" for submitting coordination drawings and subcontract list.
3. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Division 01 Section "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
5. Division 01 Section "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
6. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
7. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
8. Division 01 Section "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
9. Division 01 Section “Sustainable Design Requirements – LEED” for product documentation per credit requirements.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal Category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's final release or approval.
    g. Scheduled dates for purchasing.
    h. Scheduled date of fabrication.
    i. Scheduled dates for installation.
    j. Activity or event number.

1.5 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.

15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Electronic Submittals: Prepare submittals as PDF files.

1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to the web-based Project management software website. Enter required data in web-based software site to fully identify submittal.

2. Email: Owner requires submittals as PDF package transmitted by sending via email or uploading to the Baltimore County File Share site. Include PDF transmittal form. Include information in email subject line as requested by Architect.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Architect reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow (15) days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.

3. Resubmittal Review: Allow (15) days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow (21) days for initial review of each submittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.7 SUBMITTAL REQUIREMENTS

A. LEED Submittals: Submit LEED Submittal Form listing applicable products for use, with name of manufacturer and model number for each product; indicate material cost values and volumes (liters); indicate documents included in submittal.

1. Refer to Section 01 81 13 “Sustainable Design Requirements – LEED” for product documentation per credit requirements.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's catalog cuts.
b. Manufacturer's product specifications.
c. Standard color charts.
d. Statement of compliance with specified referenced standards.
e. Testing by recognized testing agency.
f. Application of testing agency labels and seals.
g. Notation of coordination requirements.
h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams that show factory-installed wiring.
b. Printed performance curves.
c. Operational range diagrams.
d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data..

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.
b. Schedules.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

2. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.

D. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

a. Project name and submittal number.
b. Generic description of Sample.
c. Product name and name of manufacturer.
d. Sample source.
e. Number and title of applicable Specification Section.
f. Specification paragraph number and generic name of each item.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.

a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of

color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

F. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

G. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

H. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.

6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

I. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

a. Name of evaluation organization.
b. Date of evaluation.
c. Time period when report is in effect.
d. Product and manufacturers' names.
e. Description of product.
f. Test procedures and results.
g. Limitations of use.

1.8 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.9 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Contractor's Approval: Indicate Contractor's approval for each submittal. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.10 ARCHITECT'S REVIEW

A. Contractor will preview all submittals, verify compliance, and then submit to Architect for review. Incomplete submittals will be returned to Contractor.

B. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.

1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.

C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

F. Architect will return without review submittals received from sources other than Contractor.

G. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 33 00

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Requirements:

1. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
2. Division 01 Section "Mockups" for additional construction requirements for integrated exterior mockups.
3. Division 01 Section "Execution" for Contract Document requirements for cutting and patching.
4. Divisions 02 through 33 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

1. Mockups are used for one or more of the following:

a. Verify selections made under Sample submittals.
b. Demonstrate aesthetic effects.
c. Demonstrate the qualities of products and workmanship.
d. Demonstrate successful installation of interfaces between components and systems.
e. Perform preconstruction testing to determine system performance.

2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.4 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.6 ACTION SUBMITTALS

A. Mockup Shop Drawings:

1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
2. Indicate manufacturer and model number of individual components.
3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.7 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

E. Reports: Prepare and submit certified written reports and documents as specified.

F. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.8 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: The Contractor will manage the Quality-Control Process through the Web-Based Project Management Software. Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect and Owner. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.9 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.10 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.

1. Requirements of authorities having jurisdiction supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:

1. Provide test specimens representative of proposed products and construction.
2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.

3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
5. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
6. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's and Owner’s approval of mockups before starting corresponding Work, fabrication, or construction.

    a. Allow seven days for initial review and each re-review of each mockup.

7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

L. Specialty Mockups: See Division 01 "Mockups" for additional construction requirements for integrated exterior mockups.

1.11 QUALITY CONTROL

A. Contractor Responsibilities: Tests and inspections are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified independent third party testing agency to perform quality-control services.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.

4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

C. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

E. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

F. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.

1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner, Architect, Commissioning Authority, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.12 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Contractor will engage an independent, third party, experienced, qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Contractor, and as follows:

1. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
2. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority, with copy to Contractor and to authorities having jurisdiction.
3. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
4. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
5. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, and authorities' having jurisdiction reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 43 39 - MOCKUPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict between BCPM's document and this Section, BCPM's document shall take precedence.

1.2 SUMMARY

A. Section Includes:

1. Integrated exterior mockups.
2. Room mockups.

B. Related Requirements:

1. Division 01 Section "Quality Requirements" for quality assurance requirements for aesthetic and workmanship mockups specified in other Sections.
2. Division 02 through 33 Sections specifying components for mockups including products and installation requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with Contract Document requirements.

B. Integrated Exterior Mockup: Full-size mockup of the exterior envelope constructed separately from the building but on the Project site as freestanding temporary built elements, consisting of multiple products, assemblies, and subassemblies.

C. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes; doors; windows; millwork; casework; specialties; furnishings and equipment; and lighting as indicated.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, testing and inspecting agency representative, and installers of major systems whose Work is included in mockups.

2. Review location and extent of mockups.
3. Review testing procedures to be performed on mockups.
4. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups and testing and maintain schedule for the Work.

1.5 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior and room mockups.

1. Include plans, elevations, sections, and mounting attachment and support details.
    a. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.
2. Indicate manufacturer and model number of individual components, subassemblies, and assemblies.
3. Include site location drawing indicating orientation of mockups.
4. Revise and resubmit Shop Drawings to reflect approved modifications in details and component interfaces resulting from changes made during testing procedures.

B. Delegated Design Submittal: For temporary structural supports for mockups not attached to building structure, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Preconstruction Test Reports: For integrated exterior mockups.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and acceptable to Owner and Architect.

B. Build mockup to do the following:

1. Perform preconstruction testing, such as window air- and water-leakage testing for the exterior mockup and sound testing for the room mockup.
2. Verify constructability of exterior building envelope components and assemblies.
    a. Architect shall review primary air/water barrier (i.e., waterproofing, fluid-applied air barrier, roofing vapor retarder and underlayment) and flashings prior to installation of cladding, cornice/gutter, and slate shingles.
3. Demonstrate qualities of products and workmanship and establish the standard by which the Work will be judged.
4. Demonstrate aesthetic effects and verify initial material/finish sample selections.
5. Demonstrate acceptable coordination between components and systems and show interfaces between dissimilar component materials.
6. Demonstrate compliance with specified installation tolerances.

C. Fabrication: Before fabricating or installing portions of the Work included in mockup, build mockup for each form of construction and finish required. Use materials and installation methods as required for the Work.

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Owner/Architect.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
4. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
5. Demolish and remove exterior mockup when directed.

D. Notifications:

1. Notify Architect (14) days in advance of the dates and times when the primary air/water barrier and flashings are installed but before they are concealed by cladding, cornice, or roofing materials, and when mockups will be tested.

E. Approval: Obtain Architect's approval of mockups before starting fabrication or construction of corresponding Work.

1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockup unless Architect specifically approves such deviations in writing.

1.8 COORDINATION

A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

1. Allow sufficient time in the schedule to accommodate failures of tests and inspections, resulting modifications, and re-testing and re-inspection.

B. Prior to construction of mockup, submittals required by other Sections of these Specifications for component materials included in the mockup shall have been submitted and reviewed for use in the project.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design support structure for free-standing mockups.

2.2 INTEGRATED EXTERIOR MOCKUPS

A. Construct integrated exterior mockup of typical exterior wall and roof construction, full thickness, according to approved mockup Shop Drawings and as indicated on the Drawings. Construct mockups to demonstrate constructability, coordination of trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.

B. Design and construct foundation and superstructure to support free-standing integrated exterior mockups.

C. Build integrated exterior mockups using installers and construction methods that will be used in completed construction.

D. Use specified products that have been approved by Architect. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in integrated exterior mockups.

E. The Work of integrated exterior mockups includes, but is not limited to, the following:

1. Masonry veneer.
2. Cold-formed metal framing and sheathing.
3. Air and weather barriers.
4. Thermal insulation.
5. Through-wall flashing.
6. Flashing and sheet metal trim.
7. Joint sealants.

F. Provide and document modifications to construction details and interfaces between components and systems required to properly sequence the Work, or to pass performance testing requirements. Obtain Architect's approval for modifications.

PART 3 - EXECUTION

3.1 TESTING OF INTEGRATED EXTERIOR MOCKUPS

A. Integrated Exterior Mockup Testing Agency: The Contractor is to engage a qualified independent testing agency to perform tests and inspections.

1. Testing and inspecting agency will interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Integrated Exterior Mockup Testing Services:

1. Joint Sealant Pull Testing

a. Testing Methodology: Testing of joint sealants shall be performed in accordance with ASTM C1521, Destructive Procedure, Method B.
b. Frequency: Perform (2) test per sealant type per each project-specific substrate.

c. Pass/Fail Criteria: Adequate surface preparation will be indicated by cohesive separation of the sealant from the substrate, not adhesive separation from the substrate.

C. Integrated exterior mockup will be considered defective if it does not pass tests and inspections.

1. Contractor must repair or replace any defects and retest until it passes, at no additional cost to the Owner.

D. Prepare test and inspection reports.

END OF SECTION 01 43 39

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict between BCPM's document and this Section, BCPM's document shall take precedence.

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Sections:

1. Division 01 Section "Temporary Tree & Plant Protection" for general protection of existing trees and plants.

1.3 SUBMITTALS

A. Sustainable Design Submittals: Comply with Division 01 Section "Sustainable Design Requirements – LEED".

1. EQ Credit 3: Construction Indoor Air Quality Management Plan

a. For filter media installed during construction and prior to occupancy: Documentation indicating MERV rating or filter class.

1.4 USE CHARGES

A. General: Cost or use charges for temporary facilities are not chargeable to the Owner or Architect unless specifically noted otherwise. The Owner will not accept a Contractor's cost or use charges for temporary services or facilities as a basis of claim for an adjustment in the Contract Sum or the Contract Time

1. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.

B. Water Service: The Owner will pay water service use charges for all metered water used by all entities engaged in construction activities at the Project Site.

C. Electric Power Service: The Contractor will pay electric power service use charges for all metered electric power used by all entities engaged in construction activities at the Project Site.

D. Fuel for Temporary Heat: As described in the Temporary Heat paragraph.

1.5 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

C. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces of adjacent existing buildings. Include the following:

1. Methods used to meet the goals and requirements of the Owner.
2. Concrete cutting method(s) to be used.
3. Location of construction devices on the site.
4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
5. Indicate activities that may disturb adjacent building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.

D. Vibration Monitoring Surveys: Refer to Paragraph 3.6 for requirements of pre-demolition and post-demolition surveys.

1.6 QUALITY ASSURANCE

A. Regulations: Contractor shall comply with industry standards and with applicable laws and regulations of authorities having jurisdiction including, but not limited to, the following:

1. Building code requirements.
2. Health and safety regulations.
3. Utility company regulations.
4. Police, fire department and rescue squad rules.
5. Environmental protection regulations.

B. Standards: Contractor shall comply with NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations," ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA Electrical Design Library "Temporary Electrical Facilities."

1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with the normal application of trade regulations and union jurisdictions.
2. Electrical Service: Comply with NEMA, NECA and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.7 PROJECT CONDITIONS

A. Temporary Utilities: The Contractor shall prepare a schedule indicating dates for implementation and termination of each temporary utility for which the Contractor is responsible. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of permanent service.

1. Temporary Use of Permanent Facilities: The Installer of each permanent service shall assume responsibility for its operation, maintenance, and protection during use as a construction facility prior to the Owner's acceptance, regardless of previously assigned responsibilities. The Contractor shall make permanent facilities available in accordance with the approved Project Schedule.
2. Warranty Period: The Warranty Period for the entire project shall begin on the date of Substantial Completion regardless of the start-up date for use as a temporary or permanent facility, including but not limited to materials and equipment.

B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber and Plywood: Comply with the requirements of Division 06 Section "Rough Carpentry."

B. Tarpaulins: Provide waterproof, fire-resistant, UL-labeled tarpaulins with flame-spread rating of 15 or less. For temporary enclosures, provide translucent, nylon-reinforced, laminated polyethylene or polyvinyl chloride, fire-retardant tarpaulins.

C. Temporary Fencing: By Contractor

D. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches.

E. Filter media installed during construction and prior to occupancy: Minimum MERV 8 or F5 filter class.

2.2 EQUIPMENT

A. Water Hoses: Provide 3/4-inch heavy-duty, abrasion-resistant, flexible rubber hoses 100 feet long, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge.

B. Electrical Outlets: Provide properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher voltage outlets. Provide 120-V, single phase, receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.

C. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.

D. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. At a minimum, install weather-proof sockets complete with 100 watt lamps at 20' on center in all corridor areas, circulation areas and all spaces over 400 square feet. Provide guard cages or tempered-glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.

E. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

F. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with minimum MERV 8 or F5 filter class at each return-air grille in system and remove at end of construction and clean HVAC system as required in Division 01 Section "Closeout Procedures."

2.3 TEMPORARY FACILITIES

A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Contractor to provide field office for Architect.

1. Job Meetings to occur in Contractors field office location to be determined.

C. Temporary Toilet Units: Provide self-contained, single-occupant toilet units of the chemical, aerated recirculation, or combustion type. Provide units properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Water Service: Install water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use.

1. Sterilization: Sterilize temporary water piping prior to use.

C. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnects, automatic ground-fault interrupters, and main distribution switch gear.

1. Power Distribution System: Install wiring overhead and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125 V, ac 20 ampere rating, and lighting circuits may be nonmetallic sheathed cable where overhead and exposed for surveillance.

D. Temporary Lighting: When an overhead floor or roof deck has been installed, provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating the entire system.

E. Temporary Heat: Provide temporary heat required by construction activities, for curing or drying of completed installations, or protection of installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.

1. Provide temporary heat at varying stages of the Project to allow construction operations to proceed in an orderly, sequential manner. The following stages are milestones that must be clearly identified on the CPM Schedule as described in Division 1 Section "Construction Progress Documentation." The stages of the project are defined as follows:

   a. Early Stage: The duration of the project from the start of construction to enclosure of the building. During this stage, the Contractor is responsible to provide temporary heat and any temporary enclosure to contain the heated air necessary for its own construction activities. The Contractor is responsible to furnish the equipment and fuel for their own temporary heating.
   b. Intermediate Stage: The duration of the project from the time the building is wholly or partially enclosed as determined by the Architect but prior to the operation of the permanent HVAC equipment for construction heating. During this stage, the Contractor shall provide temporary heating to establish an ambient air temperature in the building, or portion thereof, to maintain construction activities, including the provision of necessary equipment and fuel. An ambient air temperature of 50 degrees F must be capable of being maintained throughout the area of work receiving temporary heat.
   c. Final Stage: The duration of the project after building enclosure is attained and the permanent HVAC equipment is available to provide temporary heat and air conditioning as determined by the Architect. An ambient air temperature of 70 degrees F must be capable of being maintained uniformly. The Contractor is responsible to provide start-up, maintenance and operation of all permanent HVAC units and provide temporary automatic temperature control wiring and devices to properly regulate the permanent devices. The Contractor is responsible to have all permanent HVAC units that will provide temporary heat wired with their required power with service disconnects and all other NEC requirements. If power cannot be provided using the permanent electrical panel, wiring or distribution, then the Contractor must provide temporary means to meet the needs of the units. The Contractor is responsible to have all permanent gas-fired HVAC units that will be used to provide temporary heat, connected to a source for gas that will provide the necessary pressure and volume to operate the units as if they are in normal use, including compliance with applicable codes. If gas cannot be provided using the permanent gas system for the building, then the Contractor must provide temporary means to meet the needs of the units.

2. Temporary heat shall be initiated and maintained to allow the performance of work for which a particular minimum ambient temperature must be maintained to meet the criteria described in individual sections of the technical specifications and as set forth by manufacturers recommendations.
3. Temporary heat shall be provided to ensure that construction activities conform with the construction schedule and to the scheduling sequence established by the Contractor and as further directed by the Architect.
4. The term "building enclosure" refers to a level of completion of the building, or a designated portion thereof that consists of the following:

   a. Construction of roof structure, roof, insulation and roofing membrane.

b. Construction of back-up masonry or exterior metal studs with exterior sheathing.
c. Temporary enclosure of exterior wall openings. Refer to the “Temporary Enclosures” paragraph below for additional information.

5. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Heating Facilities: Except where use of the permanent system is authorized, provide properly vented self-contained LP gas or fuel oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, or open burning or salamander type heating units is prohibited.

G. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Provide separate facilities for male and female personnel.

H. Electronic Communication Service: Contractor to provide secure Wi-Fi wireless connection to internet with provisions for access by Architect and Owner only.

1. Subcontractors to provide own accommodations.

3.4 SUPPORT FACILITIES INSTALLATION

A. Storage and Fabrication Facilities: Install storage and fabrication sheds or mobile trailers, sized, furnished and equipped to accommodate materials and equipment involved. Facilities may be open shelters or fully enclosed.

B. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for a healthy and sanitary condition. Dispose of drainage properly. Supply cleaning compounds appropriate for each condition.
1. Provide safety showers, eye-wash fountains and similar facilities for convenience, safety and sanitation of personnel.

C. Drinking Water Facilities: Provide containerized tap-dispenser bottled-water type drinking water units, including paper supply.

D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water, ice, and snow.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

E. Project Signs: Contractor to provide project signs.

F. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction and Demolition Waste Management and Disposal."

G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Division 01 Section "Execution."

H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

I. Temporary Elevator Use: See Division 14 elevator Section for temporary use of new elevators.

J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Avoid using tools and equipment that produce harmful noise. Restrict use of noise-making tools and equipment to hours that will minimize complaints from persons or firms near the site.

C. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

E. Rodent and Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

F. Site Enclosure Fence: Contractor to provide site enclosure fence.

G. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

1. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.

H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

I. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

J. Covered Walkways: Contractor to provide covered walkways.

K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heat is needed and the permanent building enclosure is not complete, provide temporary insulated enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
2. Install tarpaulins securely, with incombustible wood framing and other materials. Close openings of 25 square feet or less with plywood or similar materials.
3. Close openings through floor or roof decks and horizontal surfaces with load-bearing wood-framed construction.

L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.6 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 01 50 00

SECTION 01 56 39 - TREE AND PLANT PROTECTION

PART 1 – GENERAL

1.1 SUMMARY

A. The scope of work includes all labor, materials, tools, equipment, facilities, transportation and services necessary for, and incidental to performing, all operations in connection with protection of existing trees and other plants as shown on the drawings and as specified herein.

1. Provide preconstruction evaluations
2. Provide tree and plant protection fencing.
3. Provide protection of root zones and above ground tree and plants
4. Provide pruning of existing trees and plants.
5. Coordinate with the requirements of Section Planting Soil for modifications to the soil within the root zone of existing trees and plants.
6. Provide all insect and disease control.
7. Remove tree protection fencing and other protection from around and under trees and plants.
8. Clean up and disposal of all excess and surplus material.

1.2 CONTRACT DOCUMENTS

A. Shall consist of specifications and general conditions and the drawings. The intent of these documents is to include all labor, materials, and services necessary for the proper execution of the work. The documents are to be considered as one. Whatever is called for by any parts shall be as binding as if called for in all parts.

B. It is the intent of this section that the requirements apply to all sections of the project specification such that any subcontractor must comply with the restrictions on work within designated Tree and Plant Protection Areas.

1.3 RELATED DOCUMENTS AND REFERENCES

A. Related Documents:

1. Section 31 10 00 “Site Clearing” for topsoil stripping and stockpiling.
2. Section 31 20 00 “Earth Moving” for excavation, rough grading, and subgrade preparation.
3. Section 31 25 00 “Soil Erosion and Sediment Control for temporary erosion and sediment control measures.
4. Section 32 92 00 “Turfs and Grasses” for vegetative establishment.

B. References: The following specifications and standards of the organizations and documents listed in this paragraph form a part of the specification to the extent required by the references thereto. In the event that the requirements of the following referenced

standards and specification conflict with this specification section the requirements of this specification shall prevail. In the event that the requirements of any of the following referenced standards and specifications conflict with each other the more stringent requirement shall prevail.

1. ANSI A 300 (Part 5) – Standard Practices for Tree, Shrub and other Woody Plant Maintenance, most current editions.
2. Pruning practices shall conform with recommendations “Structural Pruning: A Guide For The Green Industry”; Published by Urban Tree Foundation, Visalia, California; most current edition.
3. Glossary of Arboricultural Terms, International Society of Arboriculture, Champaign Il, most current edition.

1.4 PERMITS AND REGULATIONS

A. The Contractor shall obtain and pay for all permits related to this section of the work unless previously excluded under provision of the contract or general conditions. The Contractor shall comply with all laws and ordinances bearing on the operation or conduct of the work as drawn and specified. If the Contractor observes that a conflict exists between permit requirements and the work outlined in the contract documents, the Contractor shall promptly notify the Owner’s Representative in writing including a description of any necessary changes and changes to the contract price resulting from changes in the work.

B. Wherever references are made to standards or codes in accordance with which work is to be performed or tested, the edition or revision of the standards and codes current on the effective date of this contract shall apply, unless otherwise expressly set forth.

C. In case of conflict among any referenced standards or codes or between any referenced standards and codes and the specifications, the more restrictive standard shall apply or Owner’s Representative shall determine which shall govern.

1.5 PROTECTION OF WORK, PROPERTY AND PERSON

A. The Contractor shall protect the work, adjacent property, and the public, and shall be responsible for any damages or injury due to his/her actions.

1.6 CHANGES IN THE WORK

A. The Owner’s Representative may order changes in the work, and the contract sum should be adjusted accordingly. All such orders and adjustments plus claims by the Contractor for extra compensation must be made and approved in writing before executing the work involved.

1.7 CORRECTION OF WORK

A. The Contractor shall re-execute any work that fails to conform to the requirements of the contract and shall remedy defects due to faulty materials or workmanship upon written notice from the Owner’s Representative, at the soonest possible time that can be coordinated with other work and seasonal weather demands**.**

1.8 DEFINITIONS

All terms in this specification shall be as defined in the “Glossary of Arboricultural Terms” or as modified below.

A. Owner’s Representative: The person appointed by the Owner to represent their interest in the review and approval of the work and to serve as the contracting authority with the

Contractor. The Owner's Representative may appoint other persons to review and approve any aspects of the work.

B. Reasonable and reasonably: When used in this specification is intended to mean that the conditions cited will not affect the establishment or long-term stability, health or growth of the plant. This specification recognizes that plants are not free of defects, and that plant conditions change with time. This specification also recognizes that some decisions cannot be totally based on measured findings and that professional judgment is required. In cases of differing opinions, the Owner's Representative expert shall determine when conditions within the plant are judged as reasonable.

C. Shrub: Woody plants with mature height approximately less than 25 feet.

D. Tree and Plant Protection Area: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and defined by a circle centered on the trunk with each tree with a radius equal to the clown dripline unless otherwise indicated by the owner's representative.

E. Tree: Single and multi-stemmed plants, including palms with anticipated mature height approximately greater than 25 feet or any plant identified on the plans as a tree.

1.9 SUBMITTALS

A. ARBORIST REPORT: Prior to the start of construction, submit, for approval by the Owner's Representative, the report of a consulting arborist who is a registered Consulting Arborist® (RCA) with American Society of Consulting Arborists or an ISA Board Certified Master Arborist, which details the following information for all trees to remain on the drawings. The report shall include the following:

1. A description of each tree to remain indicating its genus and species, condition including any visible damage to the root system or soil within the root zone, tree diameter at breast height (dbh) and approximate height, size and any visible disease, insect infestations and or branch and trunk structural deficiencies.

2. The report shall note all trees or parts of trees, which are considered a hazard or significant or extreme risk level. Include the International Society of Arboriculture hazard evaluation sheet for each tree, which may reasonably be identified as a potential hazard tree.

3. Recommendations as to treatment of all insect, disease and structural problems encountered.

4. Recommendations for fertilizer treatments, if any.

5. A plan of the site showing the location of all trees included in the report.

B. PRODUCT DATA: Submit manufacturer product data and literature describing all products required by this section to the Owner's Representative for approval. Provide submittal four weeks before the start of any work at the site.

C. QUALIFICATIONS SUBMITTAL: For each applicable person expected to work on the project, provide copies of the qualifications and experience of the Consulting arborist, proof of either the registered Consulting Arborist® (RCA) with American Society of Consulting Arborists or an ISA Board Certified Master Arborist and any required Herbicide/Pesticide license to the Owner's Representative, for review prior to the start of work.

1.10 OBSERVATION OF THE WORK

A. The Owner's Representative may inspect the work at any time.

1.11 PRE-CONSTRUCTION MEETING

A. Schedule a pre-construction meeting with the Owner's Representative at least seven (7) days before beginning work to review any questions the Contractor may have regarding the work, administrative procedures during construction and project work schedule.

1. The following Contractors shall attend the preconstruction conference:

a. General Contractor.

b. Consulting Arborist.

c. Subcontractor assigned to install Tree and Plant Protection measures.

d. Earthwork Contractor.

e. All site utility Contractors that may be required to dig or trench into the soil.

f. Landscape subcontractor.

g. Irrigation subcontractor

B. Prior to this meeting, mark all trees and plants to remain and or be removed as described in this specification for review and approval by the Owner's Representative.

1.12 QUALITY ASSURANCE

A. Contractor qualifications:

1. All pruning, branch tie back, tree removal, root pruning, and fertilizing required by this section shall be performed by or under the direct supervision of ISA Certified Arborist Submit aforementioned individual's qualifications for approval by the Owner's Representative.

2. All applications of pesticide or herbicide shall be performed by a person maintaining a current state license to apply chemical pesticides valid in the jurisdiction of the project. Submit copies of all required state licensing certificates including applicable chemical applicator licenses.

PART 2 – PRODUCTS

2.1 MULCH

A. Mulch shall be coarse, ground, from tree and woody brush sources. The minimum range of fine particles shall be 3/8 inch or less in size and a maximum size of individual pieces shall be approximately 1 to 1-1/2 inch in diameter and maximum length of approximately 4 to 8 inches. No more than 25% of the total volume shall be fine particles and no more than 20% of total volume be large pieces.

1. It is understood that Mulch quality will vary significantly from supplier to supplier and region to region. The above requirements may be modified to conform to the source material from locally reliable suppliers as approved by the Owner's Representative.

B. Submit supplier's product data that product meets the requirements and two-gallon sample for approval.

2.2 WOOD CHIPS

A. Wood Chips from an arborist chipping operation with less than 20% by volume green leaves. Chips stockpiled from the tree removal process may be used.

2.3 TREE PROTECTION FENCING

A. PLASTIC MESH FENCE: Heavy - duty orange plastic mesh fencing fabric 48 inches wide. Fencing shall be attached to metal “U” or “T” post driven into the ground of sufficient depth to hold the fabric solidly in place without sagging. The fabric shall be attached to the post using attachment ties of sufficient number and strength to hold up the fabric without sagging. The Owner’s Representative may request, at any time, additional post, deeper post depths and or additional fabric attachments if the fabric begins to sag, lean or otherwise not present a sufficient barrier to access.

B. CHAIN LINK FENCE: 6 feet tall metal chain link fence set in metal frame panels on movable core drilled concrete blocks of sufficient size to hold the fence erect in areas of existing paving to remain.

C. GATES: For each fence type and in each separate fenced area, provide a minimum of one 3-foot-wide gate. Gates shall be lockable. The location of the gates shall be approved by the Owner's Representative.

D. Submit supplier’s product data that product meets the requirements for approval.

2.4 TREE PROTECTION SIGN

A. Heavy-duty cardboard signs, 8.5 inches x 11 inches, white colored background with black 2 inch high or larger letters block letters. The signs shall be attached to the tree protection fence every 50 feet o.c. The tree protection sign shall read “Tree and Plant Protection Area-Keep Out”.

2.5 MATTING

A. Matting for vehicle and work protection shall be heavy duty matting designed for vehicle loading over tree roots, Alturnamats as manufactured by Alturnamats, Inc. Franklin, PA 16323 or approved equal.

B. Submit supplier’s product data that product meets the requirements for approval.

2.6 GEOGRID

A. Geogrid shall be woven polyester fabric with PVC coating, Uni-axial or biaxial geogrid, inert to biological degradation, resistant to naturally occurring chemicals, alkalis, acids.

1. Geogrid shall be Miragrid 2XT as manufactured by Ten Cate Nicolon, Norcross, GA. http://www.tencate.com or approved equal.

B. Submit supplier’s product data that product meets the requirements for approval.

2.7 FILTER FABRIC

A. Filter Fabric shall be nonwoven polypropylene fibers, inert to biological degradation and resistant of naturally occurring chemicals, alkalis and acids.

1. Mirafi 135 N as manufactured by Ten Cate Nicolon, Norcross, GA. http://www.tencate.com or approved equal.

B. Submit supplier's product data that product meets the requirements for approval.

PART 3 – EXECUTION

3.1 SITE EXAMINATION

A. Examine the site, tree, plant, and soil conditions. Notify the Owner's Representative in writing of any conditions that may impact the successful Tree and Plant Protections that is the intent of this section.

3.2 COORDINATION WITH PROJECT WORK

A. The Contractor shall coordinate with all other work that may impact the completion of the work.

B. Prior to the start of Work, prepare a detailed schedule of the work for coordination with other trades.

C. Coordinate the relocation of any irrigation lines currently present on the irrigation plan, heads or the conduits of other utility lines or structures that are in conflict with tree locations. Root balls shall not be altered to fit around lines. Notify the Owner's Representative of any conflicts encountered.

3.3 TREE AND PLANT PROTECTION AREA: The Tree and Plant Protection Area is defined as all areas indicated on the tree protection plan. Where no limit of the Tree and Plant Protection area is defined on the drawings, the limit shall be the drip line (outer edge of the branch crown) of each tree.

3.4 PREPARATION:

A. Prior to the preconstruction meeting, layout the limits of the Tree and Plant Protection Area and then alignments of required Tree and Plant Protection Fencing and root pruning. Obtain the Owner's Representative's approval of the limits of the protection area and the alignment of all fencing and root pruning.

B. Flag all trees and shrubs to be removed by wrapping orange plastic ribbon around the trunk and obtain the Owner's Representative's approval of all trees and shrubs to be removed prior to the start of tree and shrub removal. After approval, mark all trees and shrubs to be removed with orange paint in a band completely around the base of the tree or shrub 4.5 feet above the ground.

C. Flag all trees and shrubs to remain with white plastic ribbon tied completely around the trunk or each tree and on a prominent branch for each shrub. Obtain the Owner's Representative's approval of all trees and shrubs to be remain prior to the start of tree and shrub removal.

D. Prior to any construction activity at the site including utility work, grading, storage of materials, or installation of temporary construction facilities, install all tree protection fencing, Filter Fabric, silt fence, tree protection signs, Geogrid, Mulch and or Wood Chips as shown on the drawings.

3.5 SOIL MOISTURE

A. Volumetric soil moisture level, in all soils within the Tree and Plant Protection Area shall be maintained above permanent wilt point to a depth of at least 8 inches. No soil work or other activity shall be permitted within the Tree and Plant Protection Area when the volumetric soil moisture is above field capacity. The permanent wilt point and field capacity for each type of soil texture shall be defined as follows (numbers indicate percentage volumetric soil moisture).

Soil type	**Permanent wilt point v/v**	**Field capacity v/v**
Sand, Loamy sand, Sandy loam	5-8%	12-18%
Loam, Sandy clay, Sandy clay loam	14-25%	27-36%
Clay loam, Silt loam	11-22%	31-36%
Silty clay, Silty clay loam	22-27%	38-41%

1. Volumetric soil moisture shall be measured with a digital, electric conductivity meter. The meter shall be the Digital Soil Moisture Meter, DSMM500 by General Specialty Tools and Instruments, or approved equivalent meter.

B. The Contractor shall confirm the soil moisture levels with a moisture meter. If the moisture is too high, suspend operations until the soil moisture drains to below field capacity.

3.6 ROOT PRUNING:

A. Prior to any excavating into the existing soil grade within 25 feet of the limit of the Tree and Plant Protection Area or trees to remain, root prune all existing trees to a depth of 24 inches below existing grade in alignments following the edges of the Tree and Plant Protection Area or as directed by the Owner's Representative. Root pruning shall be in conformance with ANSI A300 (part 8) latest edition.

1. Using a rock saw, chain trencher or similar trenching device, make a vertical cut within 2 feet of the limit of grading.
2. After completion of the cut, make clean cuts with a lopper, saw or pruner to remove all torn root ends on the tree side of the excavation, and backfill the trench immediately with existing soil, filling all voids.

3.7 INSTALLATION OF GEOGRIDS, FILTER FABRIC, MATTING, WOOD CHIPS AND OR MULCH

A. Install Geogrids, Filter Fabric, matting, Wood Chips and or Mulch in areas and depths shown on the plans and details or as directed by the Owner's representative. In general, it is the intent of this specification to provide the following levels of protection:

1. All areas within the Tree and Plant Protection area provide a minimum of 5 inches of Wood Chips or Mulch.
2. Areas where foot traffic or storage of lightweight materials is anticipated to be unavoidable provide a layer of Filter Fabric under the 5 inches of Wood Chips or Mulch.
3. Areas where occasional light vehicle traffic is anticipated to be unavoidable provide a layer of Geogrids under 8 inches of Wood Chips or Mulch.
4. Areas where heavy vehicle traffic is unavoidable provide a layer of Geogrids under 8

- 12 inches of Wood Chips or Mulch and a layer of matting over the Wood Chips or Mulch.

B. The Owner's Representative shall approve the appropriate level of protection.

C. In the above requirements, light vehicle is defined as a track skid steer with a ground pressure of 4 psi or lighter. A heavy vehicle is any vehicle with a tire or track pressure of greater than 4 psi. Lightweight materials are any packaged materials that can be physically moved by hand into the location. Bulk materials such as soil, or aggregate shall never be stored within the Tree and Plant Protection Area.

3.8 PROTECTION:

A. Protect the Tree and Plant Protection Area at all times from compaction of the soil; damage of any kind to trunks, bark, branches, leaves and roots of all plants; and contamination of the soil, bark or leaves with construction materials, debris, silt, fuels, oils, and any chemicals substance. Notify the Owner’s Representative of any spills, compaction or damage and take corrective action immediately using methods approved by the Owner’s Representative.

3.9 GENERAL REQUIREMENTS AND LIMITATIONS FOR OPERATIONS WITHIN THE TREE AND PLANT PROTECTION AREA:

A. The Contractor shall not engage in any construction activity within the Tree and Plant Protection Area without the approval of the Owner's Representative including: operating, moving or storing equipment; storing supplies or materials; locating temporary facilities including trailers or portable toilets and shall not permit employees to traverse the area to access adjacent areas of the project or use the area for lunch or any other work breaks. Permitted activity, if any, within the Tree and Plant Protection Area may be indicated on the drawings along with any required remedial activity as listed below.

B. In the event that construction activity is unavoidable within the Tree and Plant Protection Area, notify the Owner’s Representative and submit a detailed written plan of action for approval. The plan shall include: a statement detailing the reason for the activity including why other areas are not suited; a description of the proposed activity; the time period for the activity, and a list of remedial actions that will reduce the impact on the Tree and Plant Protection Area from the activity. Remedial actions shall include but shall not be limited to the following:

1. In general, demolition and excavation within the drip line of trees and shrubs shall proceed with extreme care either by the use of hand tools, directional boring and or Air Knife excavation where indicated or with other low impact equipment that will not cause damage to the tree, roots or soil.

2. When encountered, exposed roots, 1 inch and larger in diameter shall be worked around in a manner that does not break the outer layer of the root surface (bark). These roots shall be covered in Wood Chips and shall be maintained above permanent wilt point at all times. Roots one inch and larger in diameter shall not be cut without the approval of the owner’s representative. Excavation shall be tunneled under these roots without cutting them. In the areas where roots are encountered, work shall be performed and scheduled to close excavations as quickly as possible over exposed roots.

3. Tree branches that interfere with the construction may be tied back or pruned to clear only to the point necessary to complete the work. Other branches shall only be removed when specifically indicated by the Owner’s Representative. Tying back or

trimming of all branches and the cutting of roots shall be in accordance with accepted arboricultural practices (ANSI A300, part 8) and be performed under supervision of the arborist.

4. Matting: Install temporary matting over the Wood Chips or Mulch to the extent indicated. Do not permit foot traffic, scaffolding or the storage of materials within the Tree and Plant Protection Area to occur off of the temporary matting.

5. Trunk Protection: Protect the trunk of each tree to remain by covering it with a ring of 8 foot long 2-inch x 6 - inch planks loosely banded onto the tree with 3 steel bands. Staple the bands to the planks as necessary to hold them securely in place. Trunk protection must be kept in place no longer than 12 months. If construction requires work near a particular tree to continue longer than 12 months, the steel bands shall be inspected every six months and loosened if they are found to have become tight.

6. Air Excavation Tool: If excavation for footings or utilities is required within the Tree and Plant Protection Area, air excavation tool techniques shall be used where practical or as designed on the drawings.

    a. Remove the Wood Chips from an area approximately 18 inches beyond the limits of the hole or trench to be excavated. Cover the Wood Chips for a distance of not less than 15 feet around the limit of the excavation area with Filter Fabric or plastic sheeting to protect the Wood Chips from silt. Mound the Wood Chips so that the plastic slopes towards the excavation.

    b. Using a sprinkler or soaker hose, apply water slowly to the area of the excavation for a period of at least 4 hours, approximately 12 hours prior to the work so that the ground water level is at or near field capacity at the beginning of the work. For excavations that go beyond the damp soil, rewet the soil as necessary to keep soil moisture near field capacity.

    c. Using an air excavation tool specifically designed and manufactured for the intended purpose, and at pressures recommended by the manufacturer of the equipment, fracture the existing soil to the shape and the depths required. Work at rates and using techniques that do not harm tree roots. Air pressure shall be a maximum of 90-100 psi.

        - The air excavation tool shall be “Air-Spade” as manufactured by Concept Engineering Group, Inc., Verona, PA (412) 826-8800, or Air Knife as manufactured by Easy Use Air Tools, Inc. Allison Park, Pa (866) 328-5723 or approved equal.

    d. Using a commercial, high-powered vacuum truck if required, remove the soil from the excavation produced by the Air Knife excavation. The vacuum truck should generally operate simultaneously with the hose operator, such that the soil produced is picked up from the excavation hole, and the exposed roots can be observed and not damaged by the ongoing operation. Do not drive the vacuum truck into the Tree and Plant Protection Area unless the area is protected from compaction as approved in advance by the Owner’s Representative.

    e. Remove all excavated soil and excavated Wood Chips, and contaminated soil at the end of the excavation.

    f. Schedule the work so that foundations or utility work is completed immediately after the excavation. Do not let the roots dry out. Mist the roots several times during the day. If the excavated area must remain open overnight, mist the roots and cover the excavation with black plastic.

    g. Dispose of all soil in a manner that meets local laws and regulations.

h. Restore soil within the trench as soon as the work is completed. Utilize soil of similar texture to the removed soil and lightly compact with hand tools. Leave soil mounded over the trench to a height of approximately 10% of the trench depth to account for settlement.

- Restore any Geogrids, Filter Fabric, Wood Chips or Mulch and or matting that was previously required for the area.

3.10 TREE REMOVAL:

A. Remove all trees indicated by the drawings and specifications, as requiring removal, in a manner that will not damage adjacent trees or structures or compact the soil.

B. Remove trees that are adjacent to trees or structures to remain, in sections, to limit the opportunity of damage to adjacent crowns, trunks, ground plane elements and structures.

C. Do not drop trees with a single cut unless the tree will fall in an area not included in the Tree and Plant Protection Area. No tree to be removed within 50 feet of the Tree and Plant Protection Area shall be pushed over or up-rooted using a piece of grading equipment.

D. Protect adjacent paving, soil, trees, shrubs, ground cover plantings and understory plants to remain from damage during all tree removal operations, and from construction operations. Protection shall include the root system, trunk, limbs, and crown from breakage or scarring, and the soil from compaction.

E. Remove stumps and immediate root plate from existing trees to be removed. Grind trunk bases and large buttress roots to a depth of the largest buttress root or at least 18 inches below the topmost roots whichever is less and over the area of three times the diameter of the trunk (DBH).

1. For trees where the stump will fall under new paved areas, grind roots to a total depth of 18 inches below the existing grade. If the sides of the stump hole still have greater than approximately 20% wood visible, continue grinding operation deeper and or wider until the resulting hole has less than 20% wood. Remove all wood chips produced by the grinding operation and back fill in 8-inch layers with controlled fill of a quality acceptable to the site engineer for fill material under structures, compacted to 95% of the maximum dry density standard proctor. The Owner’s Representative shall approve each hole at the end of the grinding operation.

2. In areas where the tree location is to be a planting bed or lawn, remove all woodchips and backfill stump holes with planting soil as defined in Specification Section Planting Soil, in maximum of 12-inch layers and compact to 80 - 85% of the maximum dry density standard proctor.

3.11 PRUNING:

A. Within six months of the estimated date of substantial completion, prune all dead or hazardous branches larger than 2 inch in diameter from all trees to remain.

B. Implement all pruning recommendations found in the arborist report.

C. Prune any low, hanging branches and vines from existing trees and shrubs that overhang walks, streets and drives, or parking areas as follows:

1. Walks - within 8 feet vertically of the proposed walk elevation.

2. Parking areas - within 12 feet vertically of the proposed parking surface elevation.

3. Streets and drives - within 14 feet vertically of the proposed driving surface elevation.

D. All pruning shall be done in accordance with ANSI A300 (part 1), ISA BMP Tree Pruning (latest edition, and the "Structural Pruning: A Guide for the Green Industry", Edward Gilman, Brian Kempf, Nelda Matheny and Jim Clark, 2013 Urban Tree Foundation, Visalia CA.

E. Perform other pruning tasks as indicated on the drawings or requested by the Owner's Representative.

F. Where tree specific disease vectors are required, sterilize all pruning tools between the work in individual trees.

3.12 WATERING

A. The Contractor shall be fully responsible for ensuring that adequate water is provided to all plants to be preserved during the entire construction period. Adequate water is defined to maintain soil moisture above the permanent wilt point to a depth of 8 inches or greater.

B. The Contractor shall adjust the automatic irrigation system, if available, and apply additional water, using hoses or water tanks as required.

C. Periodically test the moisture content in the soil within the root zone to determine the water content.

3.13 WEED REMOVAL

A. During the construction period, control any plants that seed in and around the fenced Tree and Plant Protection area at least three times a year.

1. All plants that are not shown on the planting plan or on the Tree and Plant Protection Plan to remain shall be considered as weeds.

B. At the end of the construction period provide one final weeding of the Tree and Plant Protection Area.

3.14 INSECT AND DISEASE CONTROL

A. Monitor all plants to remain for disease and insect infestations during the entire construction period. Provide all disease and insect control required to keep the plants in a healthy state using the principles of Integrated Plant Management (IPM). All pesticides shall be applied by a certified pesticide applicator.

3.15 CLEAN-UP

A. During tree and plant protection work, keep the site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day. Remove trash and debris in containers from the site no less than once a week.

1. Immediately clean up any spilled or tracked soil, fuel, oil, trash or debris deposited by the Contractor from all surfaces within the project or on public right of ways and neighboring property.

B. Once tree protection work is complete, wash all soil from pavements and other structures. Ensure that Mulch is confined to planting beds.

C. Make all repairs to grades, ruts, and damage to the work or other work at the site.

D. Remove and dispose of all excess Mulch, Wood Chips, packaging, and other material brought to the site by the Contractor.

3.16 REMOVAL OF FENCING AND OTHER TREE AND PLANT PROTECTION

A. At the end of the construction period or when requested by the Owner's Representative remove all fencing, Wood Chips or Mulch, Geogrids and Filter Fabric, trunk protection and or any other Tree and Plant Protection material.

3.17 DAMAGE OR LOSS TO EXISTING PLANTS TO REMAIN

A. Any trees or plants designated to remain, and which are damaged by the Contractor, shall be replaced in kind by the Contractor at their own expense. Trees shall be replaced with a tree of similar species and of equal size or 6-inch caliper whichever is less. Shrubs shall be replaced with a plant of similar species and equal size or the largest size plants reasonably available whichever is less. Where replacement plants are to be less than the size of the plant that is damaged, the Owner's Representative shall approve the size and quality of the replacement plant.

1. All trees and plants shall be installed per the requirements of Specification Section Planting.

B. Plants that are damaged shall be considered as requiring replacement or appraisal in the event that the damage affects more than 25 % of the crown, 25% of the trunk circumference, or root protection area, or the tree is damaged in such a manner that the tree could develop into a potential hazard. Trees and shrubs to be replaced shall be removed by the Contractor at his own expense.

1. The Owner's Representative may engage an independent arborist to assess any tree or plant that appears to have been damaged to determine their health or condition.

C. Any tree that is determined to be dead, damaged, or potentially hazardous by the Owner's arborist and upon the request of the Owner's Representative shall be immediately removed by the Contractor at no additional expense to the owner. Tree removal shall include all cleanup of all wood parts and grinding of the stump to a depth sufficient to plant the replacement tree or plant, removal of all chips from the stump site and filling the resulting hole with topsoil.

D. Any remedial work on damaged existing plants recommended by the consulting arborist shall be completed by the Contractor at no cost to the owner. Remedial work shall include but is not limited to: soil compaction remediation and vertical mulching, pruning and or cabling, insect and disease control including injections, compensatory watering, additional mulching, and could include application tree growth regulators (TGR).

E. Remedial work may extend up to two years following the completion of construction to allow for any requirements of multiple applications or the need to undertake applications at required seasons of the year.

END OF SECTION

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Division 01 Section "Summary" for Contractor requirements related to Owner-furnished products.
2. Division 01 Section "Substitution Procedures" for requests for substitutions.
3. Division 01 Section "Closeout Procedures" for submitting warranties.
4. Division 01 Section “Sustainable Design Requirements – LEED” for product characteristics per credit requirements.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Division 01 Section "Submittal Procedures."

F. Substitution: Refer to Division 01 Section "Substitution Procedures" for definition and limitations on substitutions.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

a. Name of product and manufacturer.
b. Model and serial number.
c. Capacity.
d. Speed.

e. Ratings.

3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.5 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on

product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

    a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."

3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.

    a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.

    a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.

7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or

indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

a. For approval of products by unnamed manufacturers, comply with requirements in Division 01 Section "Substitution Procedures" for substitutions for convenience.

C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Division 01 Section "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

1. Select products for which sustainable design documentation submittals are available from manufacturer.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Division 01 Section "Submittal Procedures."

1. Form of Approval of Submittal: As specified in Division 01 Section "Submittal Procedures."
2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 71 23 - FIELD ENGINEERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work on this section.

B. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition. Alternate methods and/or materials may be submitted to the Architect for consideration. Those judged to be equal to that specified will receive written approval.

C. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

D. 2000 Maryland Stormwater Design Manual Vol I & II, dated May 2010 and as amended.

1.2 SUMMARY

Work included: Provided at the Contractor's expense, such field engineering services as are required for proper completion of the Work including, but not necessarily limited to:

A. The Contractor shall be responsible for all stakeouts and elevation checks required for construction. All such Work shall be performed by a professional land surveyor. The surveyor shall verify adequacy of benchmarks before starting construction.

B. Before the start of any building construction, the Contractor shall have a professional land surveyor locate and stake building corners, driveway entrances, driveways, parking areas and playfields. If there are any discrepancies between the actual layout and the project site plan, they shall be brought to the attention of the Architect and resolved before Work proceeds. A building and site stake out drawing stamped and signed by a professional land surveyor may be submitted in lieu of this preliminary stake out.

C. After the corners of the exterior walls have been started, the Contractor shall obtain a wall check survey certificate made by a professional land surveyor. This survey shall show the accurate location of the building with reference to property lines.

D. After the first sections of slab-on-grade have been placed in the building, the Contractor shall have a professional land surveyor verify and record the finish floor elevations on the wall check survey.

E. At the end of the project, the Contractor shall have a professional land surveyor prepare and certify an as-built survey showing the accurate horizontal and vertical locations of all building corners, paved areas, sidewalks, utilities (including inverts), fencing, site walls, and grading, etc. located within the project area.

F. As-Built survey shall be included in a standard C.A.D. format such as AutoCAD and/or MicroStation and shall include, at a minimum, 2-foot contours within the project limits.

G. The contractor will be responsible for scheduling the independent testing agent (ITA) during construction of the stormwater management facility and insuring that the ITA completes the necessary stormwater checklist(s) during construction.

H. A complete stormwater management as-built shall also be completed in accordance with Baltimore County's Standard Stormwater Management checklist. The Contractor shall have a professional land surveyor prepare and certify an as-built survey, and the testing and inspection agent shall have their professional engineer certify the construction checklist at the interim and final stages of stormwater management facility construction.

I. The contractor will be responsible for preparing and submitting to the project engineer five (5) copies of the final stormwater management facility as-built, testing and inspection checklist(s) and additional facility information in accordance with the requirements set forth by Baltimore County.

1.3 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

B. Additional requirements for field engineering also may be described in other Sections of these Specifications.

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.5 SUBMITTALS

A. Comply with pertinent provisions of Section 017800-Closeout Submittals.

B. Upon request of the Architect, submit;

1. Data demonstrating qualifications of persons proposed to be engaged for field engineering services.

2. Documentation verifying accuracy of field engineering work.

3. Certifications, signed by the Contractor's retained field engineer, certifying that elevations and locations of improvements are in conformance with requirements of the Contract Documents.

4. All certifications and surveys described in the Summary section of this specification.

1.6 PROCEDURES

A. In addition to procedures directed by the Contractor for the proper performance of the Contractor's responsibilities:

1. Locate and protect control points before starting Work on the site.

2. Preserve permanent reference points during process of the Work.

3. Do not change or relocate reference points or items of the Work without specific approval from the Architect.

4. Promptly advise the Architect when a reference point is lost or destroyed, or requires relations because of other changes in the Work.

    a) Upon direction of the Architect, require the field engineer to replace reference stakes or markers.

    b) Locate such replacements according to the original survey control.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

Not Applicable

END OF SECTION

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
   1. Construction layout.
   2. Field engineering and surveying.
   3. Installation of the Work.
   4. Cutting and patching.
   5. Coordination of Owner's portion of the Work.
   6. Progress cleaning.
   7. Starting and adjusting.
   8. Protection of installed construction.
   9. Correction of the Work.

B. Related Requirements:
   1. Division 01 Section "Summary" for coordination of Owner-furnished products and limits on use of Project site.
   2. Division 01 Section "Submittal Procedures" for submitting surveys.
   3. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
   4. Division 02 Section "Structure Demolition" for demolition and removal of the building.
   5. Division 07 Section "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor and professional engineer.

B. Certified Surveys: Submit (3) copies signed by land surveyor or professional engineer.

C. Certificates: Submit certificate signed by land surveyor or professional engineer, certifying that location and elevation of improvements comply with requirements.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
   1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
   2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
      a. Primary operational systems and equipment.
      b. Fire separation assemblies.
      c. Air or smoke barriers.
      d. Fire-suppression systems.
      e. Plumbing piping systems.
      f. Mechanical systems piping and ducts.
      g. Control systems.
      h. Communication systems.
      i. Fire-detection and -alarm systems.
      j. Conveying systems.
      k. Electrical wiring systems.
      l. Operating systems of special construction.
   3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
      a. Water, moisture, or vapor barriers.
      b. Membranes and flashings.
      c. Sprayed fire-resistive material.
      d. Equipment supports.
      e. Piping, ductwork, vessels, and equipment.
      f. Noise- and vibration-control elements and systems.

   4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner

that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.
   1. Use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
   1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
   1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
   2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
   1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
   2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
   3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Division 01 Section "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.

B. Engage a land surveyor or professional engineer experienced in laying out the Work, using the following accepted surveying practices:

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
   1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
   2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
   1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
   2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
   3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb, and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
   4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 84 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
   2. Allow for building movement, including thermal expansion and contraction.
   3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of Work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to adjacent buildings.

F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

A. Site Access: Provide access to Project site for Owner's construction personnel.
1. Provide temporary facilities required for Owner-furnished, Contractor-installed products.
2. Refer to Division 01 Section "Summary" for other requirements for Owner-furnished, Contractor-installed products.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
   2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
      a. Use containers intended for holding waste materials of type to be stored.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.
   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in 017419 "Construction and Demolition Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Division 01 Section "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 00

SECTION 01 74 19 – CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. Reduce construction and demolition waste on project site and minimize waste sent to landfills and incineration through implementation of a Construction and Demolition Waste Management Plan as required by LEED® version 4.0 (v4.0) Building Design and Construction (LEED BD+C: New Construction) Rating System and as outlined within this section. Throughout this section, the term LEED is used in place of LEED BD+C: New Construction.

B. Related sections: The following sections contain requirements that relate to this section:
   1. Division 01 Section “Sustainable Design Requirements-LEED” for definitions and reference standards relating to waste management, referenced herein.
   2. Division 02 Sections referring to demolition.

1.2 REFERENCES

A. LEED v4.0 for Building Rating System and Getting Started Guide for Building Design and Construction (BD+C)
   1. Materials and Resources (MR) Prerequisite 2: Construction and Demolition Waste Management Planning
   2. MR Credit 5: Construction and Demolition Waste Management

B. Recycling Certification Institute certification program for recycling facilities

1.3 PRELIMINARY SUBMITTALS

A. Prior to any waste removal and in advance of the Pre-Construction Meeting, submit for approval a detailed Waste Management Plan in accordance with LEED MR Prerequisite 2 and Credit 5 requirements and as outlined in this Section.
   1. LEED v4.0 MR Prerequisite 2: Identify at least five materials (both structural and nonstructural) to be targeted for diversion.
      a. Provide an estimated percentage of the overall project waste that these materials represent, and diversion goals for each.
   2. LEED v4.0 MR Credit 5: Achieve the following waste management goal(s):
      a. Option 1, Path 2 – Divert at least 75 percent, of total construction and demolition waste, identifying at least four individual material waste streams, from landfill or incinerator, by weight or volume.
         1) Commingled waste is calculated as one material stream unless the sorting facility provides diversion rates for specific materials using weight or volume.
   3. Describe means and methods to achieve required goal.
      a. Indicate whether materials will be separated on site or comingled.
      b. Identify recycling contractors and haulers proposed for the project and locations accepting waste materials or entities providing related services.
      c. Describe how the recycling facility will process the material.
      d. For multiple waste streams: Provide statement that project specific diversion rates will be provided, by weight or volume.
      e. Commingled sorting facilities:

1) Provide end destination and intended use for diverted materials.
2) For one commingled waste stream: Provide average annual recycling rate for the facility provided by the regulating local or state government authority. Confirm alternative daily cover (ADC) is considered undiverted waste and is excluded from the average annual diversion rate.

f. Visual inspection is not an acceptable method of inspection for purposes of documenting percentage of comingled waste diverted from landfill.

1.4 INFORMATIONAL SUBMITTALS

A. With each Application for Payment, submit waste management progress reports, demonstrating MR Credit 5.
1. Project title, name of party completing report, and dates of period covered by the report.
2. Amount (by weight or volume) of recycled and/or salvaged construction and demolition waste to date, include the identified three material streams.
a. Exclude excavated soil, land-clearing waste from calculations.
b. Include materials destined for alternative daily cover (ADC) as landfilled waste.
c. Include materials reused on site as diverted from landfill in calculations.
d. Include materials sent to incinerators as diverted from landfill in calculations.
e. Include all materials donated, sent to reuse facility, or reused off-site as diverted from landfill in calculations.
f. Include wood waste converted to fuel (biofuel) or waste-to-energy as diverted from landfill in calculations.
1) Exclude all other types of waste-to-energy from calculations.
g. Comingling sorting facilities: Provide summary of diversion rates, type of materials recycled and description of the end destination of the recycled materials.

1.5 CLOSEOUT SUBMITTALS

A. LEED Online: At completion of construction and prior to contract closeout, complete the LEED Online Form on the LEED Online Project Database for MR Prerequisite 2 and Credit 5 and upload the associated required documentation.
1. MR Prerequisite 2: Construction and Demolition Waste Management Plan
2. MR Credit 5: Construction and Demolition Waste Management Calculator and summarize final waste management reports detailing all waste generated, including disposal and diversion rates for the project.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 WASTE MANAGEMENT PLAN IMPLEMENTATION, GENERAL

A. Designate one employee or consultant as the Contractor Waste Management Coordinator for this Project.
1. Maintain access to LEED Online at project award and throughout project.
2. Oversee the demolition and construction waste activities for the project.
3. Instruct workers concerning the sustainable building goals.
4. Prepare and oversee CWM related submittals.
5. Complete final LEED documentation for CWM prerequisite and credit.

B. Training and Coordination:

1. Furnish copies of approved Waste Management Plan to all on-site supervisors, each subcontractor, Owner, and Architect.
2. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all entities at the appropriate stages of the Project.
3. Meetings: Include construction waste management on the agenda of all required regularly scheduled construction meetings.

C. Facilities: Provide designated facilities for co-mingling or separation and storage of materials for recycling, salvage, reuse, return, donation and waste disposal, per approved Waste Management Plan for use by all contractors and installers.
1. Provide adequate space, convenient to subcontractors, for pick-up and delivery.
2. Keep recycling and waste bin areas neat and clean to avoid contamination of materials.

D. Records: Maintain on-site logs for each load of materials removed from site:
1. Include type of material, load (by weight or volume), recycling/hauling service, and date accepted by service or non-profit receiver.
    a. Comingling waste as a single stream: provide documentation of percentages of diverted waste from the sorting facility for the corresponding month.
    b. Comingled waste as multiple streams: provide documentation of percentages of individual waste streams based on weight or volume.

E. Methods of waste disposal that are not acceptable for LEED compliance:
1. Burning or incinerating on or off project site, except as described in PART 1 of this section.
2. Burying on project site, other than fill.
3. Dumping or burying on other property, public or private, other than official landfill.
4. Illegal dumping or burying.

F. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
1. Materials qualifying as reused for MR Credit 3: Sourcing of Raw Materials contribute as diverted waste in calculations for MR Credit 5, Option 1.
2. Concrete, masonry and asphalt crushed and reused on-site contribute as diverted waste to calculations for MR Credit 5, Option 1 and do not contribute to MR Credit 3: Sourcing of Raw Materials as reused materials.
    a. MR Credit 3: 100 percent recycled content and regional content.
    b. MR Credit 5: 100 percent diverted from land fill.
3. Reused materials do not contribute to MR Credit 5, Option 2.

G. Salvage of Materials: Set aside, sort, and protect products to be salvaged for reuse off-site.
1. For renovation projects: Re-sale of existing furniture is acceptable means for diversion.

H. Hazardous Waste Handling: Separate, store and dispose of hazardous wastes separately from other materials and in accordance with local regulations.

END OF SECTION 01 74 19

SECTION 01 75 00
GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Commissioning: Commissioning is a systematic process of validating that all building systems perform interactively according to the design intent and the owner's operational needs. This is achieved by beginning in the design phase and documenting design intent and continuing through construction, acceptance and the warranty period with actual verification of performance. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training.

Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents.

1. Review Owner's Project Requirements (OPR) and the A/E Basis of Design (BOD) documents and ensures Owners requirements are met.
2. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
3. Verify and document proper performance of equipment and systems.
4. Verify that O&M documentation left on site is complete.
5. Verify that the Owner's operating personnel are adequately trained.
6. Review trends and seasonal checkout.

B. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

C. Abbreviations: The following are common abbreviations used in the Specifications and in the Commissioning Plan. Definitions are found in Section 1.6.

1. A/E - Architect and Design Engineers
2. CxA - Commissioning Authority
3. CC - Controls Contractor
4. CA - Construction Administrator (of A/E)
5. CM – Construction Manager
6. Cx - Commissioning
7. Cx Plan - Commissioning Plan Document
8. EC - Electrical Contractor
9. FPT - Functional Performance Test
10. GC - General Contractor
11. MC - Mechanical Contractor
12. OPM - Owner's Project Manager (of the Owner)
13. PFC - Pre-functional Checklist
14. Subs - Subcontractors to General
15. TAB - Test, Adjust and Balance Contractor

1.2 DEFINITIONS

A. Commissioning Plan: A document, prepared by the CxA, that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

C. BOD: Basis of Design: A document, prepared by the Architect and Engineers, that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

D. OPR: Owner's Project Requirements: A document, prepared by the Owner and Architect, that details the functional requirements of the Project and expectations of how it will be used and operated. This document includes Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information

1.3 COORDINATION

A. Commissioning Team: The members of the commissioning team consist of the Commissioning authority (CxA), the Construction Administrator of Architect and Engineer (A/E), the designated representative of the General Contractor firm (GC or Contractor), the architect and design engineers (particularly the mechanical engineer), the Mechanical Contractor (MC), the Electrical Contractor (EC), the TAB Contractor representative, the Controls Contractor (CC), any other installing subcontractors or suppliers of equipment. If known, the Owner's building or plant operator/engineer is also a member of the commissioning team.

B. Management: The CxA is hired by the A/E directly. The CxA directs and coordinates the commissioning activities and reports to the A/E. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.

C. Scheduling: The CxA will work with the GC according to established protocols to schedule the commissioning activities. The GC will provide sufficient notice to the CxA for scheduling commissioning activities. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

D. The CxA will provide the general schedule overview of primary commissioning events at the commissioning scoping meeting. The Commissioning Plan - Construction Phase provides a format for this schedule. As the construction progresses, the GC will provide to the CxA and Owner more detailed schedules based on work progress and construction activities. The Cx Plan also provides a format for detailed schedules.

1.4 COMMISSIONING PROCESS

A. Commissioning Plan: The Cx Plan described herein is binding on the Contractor. The Cx Plan provides guidance in the execution of the commissioning process. The Cx Plan may be adjusted for a specific project after the initial Cx scope meeting. The Specification*s* will take precedence over the Cx Plan.

B. Commissioning Process: The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.

1. Commissioning during construction begins with a scoping meeting conducted by the CxA where the commissioning process is reviewed with the commissioning team members.
2. Additional meetings will be required throughout construction, scheduled by the CxA with necessary parties attending, to plan, scope, coordinate, and schedule future activities and resolve problems.
3. Equipment documentation and submittals shall be submitted to the CxA during normal submittal processing, including detailed startup procedures.
4. The CxA works with the Subs in developing pre-functional checklists to be completed during the startup process by the installing contractors.
5. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with pre-functional

checklists being completed by the installing contractors and approved by CxA before functional testing.

6. The Subs, under their own direction, execute and document the pre-functional checklists and perform startup and initial checkout procedures, as required by relevant equipment specifications. The Subs shall provide advanced notice of major equipment startups to the CxA, the CxA shall attend equipment startups at their discretion. The Subs submit all completed manufacturer startup forms and pre-functional checklists to the CxA, who documents that the checklists and startup were completed according to the approved plans.
7. The Testing, Adjusting, and Balancing Sub shall complete all work and submit a final TAB report prior to functional performance testing of equipment and systems. This report must be approved by the A/E and CxA.
8. The CxA develops specific equipment and system functional performance test procedures and provides them to the Subs for review.
9. The procedures are executed by the Subs, under the direction of, and documented by, the CxA.
10. Items of non-compliance in material, installation or setup are corrected at the Sub's expense and the system is retested.
11. The CxA reviews the O&M documentation for completeness.
12. Commissioning is completed before substantial completion.
13. The CxA reviews, pre-approves and witnesses the training provided by the Subs and verifies that it was completed. The GC shall coordinate all training, as required.
14. Deferred testing is conducted, as specified or required.

1.5 RELATED WORK

A. Specific commissioning requirements are given in the following Sections of these Specifications. All of the following Sections apply to the Work of this Section.

1. 00 72 00 "General Conditions" - Provides for liquidated damages to be paid by the Contractor if commissioning is not completed by the Substantial Completion milestone.
2. 01 33 00 "Submittal Procedures" - Alerts all parties that additional detail in submittals may be required and directs to Division 01.
3. 01 77 00 "Closeout Procedures" - Defines Substantial Completion and Final Completion milestones, relative to commissioning and directs to Division 01.
4. 01 78 23 "Operation and Maintenance Data" - Alerts all parties of O&M documentation requirements.
5. 22 08 00 "Commissioning of Plumbing" - Describes commissioning responsibilities of the plumbing contractor and points to Sections 22 08 19 for sample forms and checklists.
6. 23 05 93 "Testing, Adjusting, and Balancing" – Describes the requirements of the TAB contractor and systems to be balanced.
7. 23 08 00 "HVAC Systems Commissioning" - Describes the commissioning responsibilities of the mechanical, controls and TAB contractors and the pre-functional testing and startup responsibilities of each. Points to Section 23 08 19 for sample forms and checklists.
8. 26 08 00 "Electrical Systems Commissioning" - Describes commissioning responsibilities of the electrical contractor and points to Sections 23 08 19 for sample forms and checklists.
9. 27 08 00 "Communications Systems Commissioning" – Describes commissioning responsibilities of the electrical contractor and points to Section 23 08 19 for sample forms and checklists.

1.6 RESPONSIBILITIES

A. The responsibilities of various parties in the commissioning process are provided in this Section. The responsibilities of the trade contractors are identified in each Division in addition to this section.

1. Division 21: Fire Suppression
2. Division 22: Plumbing.
3. Division 23: Mechanical.
4. Division 26: Electrical.
5. Division 27: Communications.
6. Division 28: Electronic Safety and Security.

B. All Parties:
   1. Follow the Commissioning Plan.
   2. Attend commissioning scoping meeting and additional meetings, as requested by the CxA.

C. Architect (of A/E):
   1. Construction and Acceptance Phase
      a. Provide support to the Commissioning Team who must provide a service as a part of the commissioning process. This shall include providing adequate space for equipment installation and maintenance.
      b. Conduct periodic inspections of work in progress to ensure that all systems and equipment are installed according to specifications.
      c. PM manages the CxA contract for the Owner, including copying the CxA on all relevant documentation and communication.
      d. Attend the commissioning scoping meeting and selected commissioning team meetings as requested by the CxA.
      e. Perform normal submittal review, and copy the CxA for construction observations, as-built drawing preparation, O&M manual preparation, etc., as contracted.
      f. Provide any design narrative documentation requested by the CxA, including BOD and OPR.
      g. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.
      h. Coordinate resolution of design deficiencies identified during the construction phase.
      i. Prepare and submit final as-built design intent documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.

   2. Warranty Period
      a. Coordinate resolution of design non-conformance and design deficiencies identified during warranty-period commissioning.

D. Mechanical, Electrical, and Plumbing Designers/Engineers (of the A/E)

   1. Construction and Acceptance Phase:
      a. Provide documentation of initial design concepts, and Design Intent based on the Owner’s program.
      b. Provide mechanical system design parameters and obtain approval of Owner.
      c. Prepare contract documents incorporating the Commissioning Specification requirements, and description of mechanical system.
      d. Attend initial meeting with TAB representative as schedules by the Commissioning Authority.
      e. Review TAB report and verification data sheets for system conformance to contract documents. Issue a report noting deficiencies requiring correction to the Commissioning Authority.
      f. Review functional performance testing report for deficiencies in meeting the finalized design intent.
      g. Review as-built records as required by contract documents and turn them over to the CxA for inclusion in the final project documentation.
      h. Review and comment on the final commissioning report.

i. Perform normal submittal review, construction observation, as-built drawing preparation, etc., as contracted. One site observation should be completed just prior to system startup.
j. Provide any design narrative and sequences documentation requested by the CxA. The designers shall assist (along with the contractors) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
k. Attend commissioning scoping meetings and other selected commissioning team meetings, as required or requested by CxA.
l. Participate in the resolution of system deficiencies identified during commissioning, according to the contract documents.
m. Prepare and submit the final as-built design intent and operating parameters documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.
n. Sign-off (final approval) on individual commissioning tests as completed and passing. Recommend completion of the commissioning process to the Project Manager.
o. Participate in Owner training and provide overview of systems and intended operation.

2. Warranty Period
a. Participate in the resolution of non-compliance, non-conformance and design deficiencies identified during commissioning during warranty-period commissioning.

E. Commissioning Authority (CxA)
1. The CxA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CxA may assist with problem-solving non-conformance or deficiencies, but ultimately that responsibility resides with the general contractor, subcontractors, and the A/E. The primary role of the CxA is to develop and coordinate the execution of a testing plan, observe and document performance—that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents. The Contractors will provide all tools to start, check-out, and functionally test equipment and systems.

2. Construction and Acceptance Phase
a. Coordinates and directs the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines, schedules, and technical expertise.
b. Coordinate the commissioning work with the PM, GC, and CA, who ensure that commissioning activities are being scheduled into the master schedule.
c. Revise, as necessary, the Commissioning Plan - Construction Phase.
d. Plan and conduct a commissioning scoping meeting and other commissioning meetings.
e. Request and review additional information required to perform commissioning tasks, including O&M manuals, contractor startup and checkout procedures.
f. Before startup, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.
g. Review normal Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with the A/E reviews.
h. Write and distribute pre-functional tests and checklists.

i. Perform site visits to observe component and system installations. Attend selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies.
j. May witness the HVAC&R piping tests and flushing procedures, sufficient to be confident that proper procedures were followed. Notify owner's project manager of any deficiencies in results or procedures.
k. May witness ductwork testing and cleaning procedures, sufficient to be confident that proper procedures were followed. Notify owner's project manager of any deficiencies in results or procedures.
l. Approve pre-functional tests and checklist completion by reviewing pre-functional checklist reports and by selected site observations and spot checking.
m. Verify systems startup by reviewing startup reports and by selected site observation.
n. Review TAB execution plan.
o. Verify air and water systems balancing by spot testing, by reviewing completed reports, and by selected site observation.
p. With necessary assistance and review from installing contractors, write the functional performance test procedures for equipment and systems. This may include energy management control system trending, stand-alone data logger monitoring or manual functional testing. Submit to PM for review, and for approval if required.
q. Analyze any functional performance trend logs and monitoring data to verify performance or equipment and systems.
r. Coordinate, witness, and approve manual functional performance tests performed by installing contractors. Request retesting as necessary.
s. Maintain a master deficiency and resolution log and a separate testing record. Provide the PM with written progress reports and test results with recommended actions.
t. Witness the training of the Owner's operating personnel.
u. Review of the O&M manuals.
v. Provide a final commissioning report (as described in this section).

3. Warranty Period
   a. Coordinate and witness required Function Performance Testing and deficiency corrections.

F. Construction Administrator of Architect and Engineer (A/E)
1. Construction and Acceptance Phase
   a. Facilitate the coordination of the commissioning work by the CxA for design related components and clarifications, as requested by the CxA.
   b. Provide support to the Commissioning Team who must provide a service as a part of the commissioning process. This shall include providing adequate space for equipment and maintenance.
   c. Review and approve the final Commissioning Plan - Construction Phase.
   d. Attend a commissioning scoping meeting and other commissioning team meetings, as requested by the CxA.
   e. Perform the normal review of Contractor submittals.
   f. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CxA.
   g. When necessary, observe and witness pre-functional checklists, startup and functional testing of selected equipment.
   h. Review commissioning progress and deficiency reports.
   i. Coordinate the resolution of non-compliance and design deficiencies identified in all phases of commissioning.

2. Warranty Period
   a. Assist the CxA as necessary in the seasonal or deferred testing and deficiency corrections required by the specifications.

G. Construction Manager (GC)
1. Construction and Acceptance Phase
   a. Include cost of commissioning requirements in the contract price. In each purchase order or subcontract written, include requirements for submittal data, O&M data, commissioning tasks and training.
   b. Include commissioning requirements in the mechanical, electrical, plumbing, controls, TAB, and all other sub-contractors contracts, to ensure full cooperation of all parties in the mechanical commissioning program.
   c. Ensure acceptable representation, with the means and authority to prepare and coordinate execution of the commissioning program as described in the contract documents.
   d. Submit the following information for each Contractor and sub-discipline assigned as representatives to the commissioning team within two weeks of contract award.
      1) Company Name
      2) Name
      3) Years of Experience
      4) Phone Number
      5) Email address
   e. Submit a complete list of project submittals required to the Architect by Division 01. The CxA will issue comments directly to the A/E for incorporation into one set of review comments to be issued to the Contractor.
   f. Submit to the CxA all Division 21, 22, 23, 26, 27, and 28 Quality Control Submittals in accordance with the requirements of individual sections.
   g. Coordinate with CxA to incorporate all commissioning events in the Master Construction Schedule. The GC shall ensure that all testing requirements for the project are incorporated into the Master Schedule and are distributed to the Owner, CxA, A/E, and all other relevant parties.
   h. Include the CxA on the construction meeting minutes distribution list.
   i. Furnish a copy of all construction documents, addenda, change orders, test reports, and approved submittals and shop drawings related to commissioned equipment to the CxA.
   j. Coordinate all construction meetings requested by the CxA, and ensure all Subcontractors and other applicable parties are in attendance.
   k. Issue a statement that TAB work has been completed, and submit the final TAB reports for review.
   l. Ensure checklists are completed during construction.
   m. Provide all manufacturer equipment startup sheets with submittals for each piece of equipment being commissioned.
   n. Issue a statement that controls systems have been calibrated, and point to point checks have been completed.
   o. Coordinate the remediation of deficiencies identified in verifications tests, start-ups, pre-functional checklists, punchlists, and other deficiencies noted during construction.
   p. Facilitate the coordination of the commissioning work by the CxA, and with the Subs to ensure that commissioning activities are being scheduled and being completed based on the master schedule.
   q. Coordinate as scheduled all subcontractors and startup testing.
   r. Evaluate any performance deficiencies identified in the FPT report for non-conformance with contract documents.

s. Coordinate the preparation of O&M manuals with the installing contractors and Subs, according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
t. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions according to the Commissioning Plan - Construction Phase.
u. Provide final approval for the completion of the commissioning work.

2. Warranty Period
   a. Ensure that Subs execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications
   b. Ensure that Subs correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing

1.7 DEFINITIONS

A. Acceptance Phase - phase of construction after startup and initial checkout when functional performance tests, O&M documentation review and training occurs.

B. Approval - acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the Contract Documents.

C. Architect / Engineer (A/E) - the prime consultant (architect) and sub-consultants who comprise the design team, generally the HVAC mechanical designer/engineer and the electrical designer/engineer.

D. Basis of Design - The basis of design is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the design intent. The basis of design describes the systems, components, conditions and methods chosen to meet the intent. Some reiterating of the design intent may be included.

E. Commissioning Authority (CxA) - an independent agent, not otherwise associated with the A/E team members or the Contractor, though he/she may be hired as a subcontractor to them. The CxA directs and coordinates the day-to-day commissioning activities. The CxA does not take an oversight role like the CA. The CxA shall report directly to the OPM.

F. Commissioning Plan - an overall plan, developed before or after bidding, that provides the structure, schedule and coordination planning for the commissioning process.

G. Construction Administrator (CA) – an agent of the A/E, tasked with managing and coordinating the construction process for the Owner, as well as managing the contract of the GC. This individual is a primary recipient of commissioning communication.

H. Contract Documents - the documents binding on parties involved in the construction of this project (drawings, specifications, change orders, amendments, contracts, Cx Plan, etc.).

I. Contractor - the general contractor or authorized representative.

J. Control system - the central building energy management control system.

K. Data logging - monitoring flows, currents, status, pressures, etc. of equipment using stand-alone data loggers separate from the control system.

L. Deferred Functional Tests - FPTs that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that disallow the test from being performed.

M. Deficiency - a condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent).

N. Design Narrative or Design Documentation - sections of either the OPR or Basis of Design.

O. Factory Testing - testing of equipment on-site or at the factory by factory personnel with an Owner's representative present.

P. Functional Performance Test (FPT) - test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The commissioning authority develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. FPTs are performed after prefunctional checklists and startup is complete.

Q. General Contractor (GC) - the prime contractor for this project. Generally refers to all the GC's subcontractors as well. Also referred to as the Contractor in some contexts.

R. Indirect Indicators - indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.

S. Manual Test - using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").

T. Monitoring - the recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.

U. Non-Compliance - see Deficiency.

V. Non-Conformance - see Deficiency.

W. Over-written Value - writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50°F to 75°F to verify economizer operation). See also "Simulated Signal."

X. Owner-Contracted Tests - tests paid for by the Owner outside the GC's contract and for which the CxA does not oversee. These tests will not be repeated during functional tests if properly documented.

Y. Owner's Project Manager (OPM) - the contracting and managing authority for the owner over the design and/or construction of the project, a staff position. This individual manages and assists the CxA throughout the construction process.

Z. Owner's Project Requirements (OPR) - a dynamic document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the owner. It is initially the outcome of the programming and conceptual design phases.

AA. Phased Commissioning - commissioning that is completed in phases (by floors, for example) due to the size of the structure or other scheduling issues, in order minimize the total construction time.

BB. Pre-functional Checklist (PFC) - a list of items to inspect, and elementary component tests to conduct, to verify proper installation of equipment, provided by the CxA to the Sub. Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some pre-functional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three phase pump motor of a chiller system). The word pre-functional refers to before functional testing. Pre-functional checklists augment and are combined with the manufacturer's startup checklist. Even without a commissioning process, contractors typically perform some, if not many, of the pre-functional checklist items a commissioning authority will recommend. However, few contractors document in writing the execution of these checklist items. Therefore, for most equipment, the contractors execute the checklists on their own. The commissioning authority only requires that the procedures be documented in writing, and does not witness much of the pre-functional check listing, except for larger or more critical pieces of equipment.

CC. Sampling - functionally testing only a fraction of the total number of identical or near identical pieces of equipment.

DD. Seasonal Performance Tests - SFT's that are deferred until the system(s) will experience conditions closer to their design conditions.

EE. Simulated Condition - condition that is created for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).

FF. Simulated Signal - disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.

GG. Specifications - the construction specifications of the Contract Documents.

HH. Startup - the initial starting or activating of dynamic equipment, including executing pre-functional checklists.

II. Subs - the subcontractors to the GC who provide and install building components and systems.

JJ. Test Procedures - the step-by-step process which must be executed to fulfill the test requirements. The test procedures are developed by the CxA.

KK. Test Requirements - requirements specifying what modes and functions, etc. shall be tested. The test requirements are not the detailed test procedures. The test requirements are specified in the Contract Documents (Sections XX 08 00 for each Division).

LL. Trending - monitoring using the building control system.

MM. Vendor - supplier of equipment.

NN. Warranty Period - warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

OO. 20 08 XX - Series of drawings or specification sections to be commissioned.

1.8 SYSTEMS TO BE COMMISSIONED

A. The systems to be commissioned in the project include but are not limited to:
1. Division 21: FIRE SUPPRESSION COMMISSIONING, SECTION 210800
2. Division 22: PLUMBING COMMISSIONING, SECTION 220800
3. Division 23: HVAC COMMISSIONING, SECTION 230800
4. Division 26: ELECTRICAL COMMISSIONING, SECTION 260800
5. Division 27: COMMUNICATIONS COMMISSIONING, SECTION 270800
6. Division 28: SAFETY AND SECURITY COMMISSIONING, SECTION 280800

B. Refer to each Section in each Division listed above for specific installation and performance verification testing requirements. Each Division has commissioning sections specific to the applicable trades work.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Division contractor for the equipment being tested. For example, the mechanical contractor of Division 23 shall ultimately be responsible for all standard testing equipment for the HVAC system and controls system in Division 23, except for equipment specific to and used by TAB in their commissioning responsibilities. Two-way radios, ladders and access to equipment shall be provided by the Division Contractor(s).

B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site.

C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance within the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

D. Refer to Section 017500, Part 3 for details regarding equipment that may be required to simulate required test conditions.

PART 3 - EXECUTION

3.1 MEETINGS

A. Scoping Meeting: Within 60 days of commencement of construction, the CxA will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the CxA. Information gathered from this meeting will allow the CxA to revise the Draft 2 Commissioning Plan to its "final" version, which will also be distributed to all parties.

B. Miscellaneous Meetings: Other meetings will be planned and conducted by the CxA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular Subs. The CxA will plan these meetings and will minimize unnecessary time being spent by Subs. For this project, these meetings may be held monthly, until the final months of construction when they may be held as frequently as one per week at the discretion of the CxA (typically 4 months prior to completion of construction).

3.2 REPORTING

A. The CxA will provide regular reports to the A/E and GC with increasing frequency as construction and commissioning progresses.

B. The CxA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning findings through progress reports, emails, etc.

C. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.

3.3 SUBMITTALS

A. At minimum, the Submittal Documentation will include the manufacturer and model number, the manufacturer's printed installation and detailed startup procedures, full sequences of operation, O&M data, performance data, any performance test procedures, control drawings and details of owner contracted tests, in addition to any specific requirements from the equipment specifications sections. Optional accessories and equipment not provided for the project shall not be shown in submittals and IOMs. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CxA. All documentation requested by the CxA will be included by the Subs in their O&M manual contributions.

B. The CxA will review submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures and only secondarily to verify compliance with equipment specifications. The CxA will notify the OPM or A/E as requested, of items missing or areas that are not in conformance with Contract Documents and which require resubmission.

C. The CxA may request additional design narrative from the A/E and Controls Contractor, depending on the completeness of the OPR documentation and sequences provided with the Specifications.

D. These submittals to the CxA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the CxA will review them.

3.4 PRE-FUNCTION CHECKLISTS, STARTUP AND INITIAL CHECKOUT

A. The following procedures apply to all equipment to be commissioned, according to Section 1.7, Systems to be Commissioned.

B. General: Pre-functional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full pre-functional checkout. No sampling strategies are used. The pre-functional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system. Completion of all pre-functional checklists is a requirement of Substantial Completion.

C. Startup and Initial Checkout Plan: The primary role of the CxA in this process is to compile all documentation verifying the manufacturer-recommended procedures have been completed. Parties responsible for pre-functional checklists and startup are identified in the commissioning scoping meeting and in the checklist forms. Parties responsible for executing functional performance tests are identified in the testing requirements in Sections XX 08 00 and other sections where tests requirements are found.
   1. The CxA adapts, if necessary, the representative pre-functional checklists and procedures. These checklists indicate required procedures to be executed as part of startup and initial checkout of the systems and the party responsible for their execution.
   2. These checklists and tests are provided by the CxA to the Contractor. The Contractor determines which trade is responsible for executing and documenting each of the line item tasks and notes that trade on the form.
   3. The subcontractor responsible for the purchase of the equipment develops the full startup plan by combining (or adding to) the CxA's checklists with the manufacturer's detailed

startup and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.

4. The subcontractor submits the full startup plan to the CxA for review.
5. The CxA reviews the procedures and the format for documenting them, noting any procedures that need to be added.
6. The full startup procedures and the approval form may be provided to the GC for review and approval, depending on management protocol.

D. Sensor and Actuator Calibration

1. All field-installed temperature, relative humidity, CO, CO_2 and pressure sensors and gauges, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described below. Alternate methods may be used, if approved by the Owner before-hand. All test instruments shall have had a certified calibration within the last 12 months. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
2. All procedures used shall be fully documented on the pre-functional checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.
3. Sensor Calibration Methods
   a. All Sensors. Verify that all sensor locations are appropriate and away from causes of erratic operation. Verify that sensors with shielded cable are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading of each other, for pressure. Tolerances for critical applications may be tighter.
   b. Sensors Without Transmitters--Standard Application. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS) is within the tolerances in the table below of the instrument-measured value. If not, install offset in BAS, calibrate or replace sensor.
   c. Sensors With Transmitters--Standard Application. Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer's resistance-temperature data, simulate minimum desired temperature. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the BAS. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction. Reconnect sensor. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS) is within the tolerances in the table below of the instrument-measured value. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.
   d. Tolerances, Standard Applications

Sensor	Required Tolerance (+/-)
Cooling coil water temps	0.5F
AHU wet bulb or dew point	0.5F
Outside air, space air, duct air temps	0.5F
Watt hour, voltage & amperage	1%
Pressures, air, water and gas	2%
Flow rates, air	5%

Flow rates, water	4% of design
Relative humidity	3% of design
Combustion flue temps	4.0F
Oxygen or CO_2 monitor	0.1 % pts
CO monitor	0.01 % pts
Barometric pressure	0.1 in. of Hg

4. Valve and Damper Stroke Set-up and Check

   a. EMS Readout: For all valve and damper actuator positions checked, verify the actual position against the BAS readout.

   b. Set pumps or fans to normal operating mode. Command valve or damper closed, visually verify that valve or damper is closed and adjust output zero signal as required. Command valve or damper open, verify position is full open and adjust output signal as required. Verify fail-safe operation. Command valve or damper to a few intermediate positions. If actual valve or damper position doesn't reasonably correspond, replace actuator.

E. Execution of Pre-functional Checklists and Startup
   1. Four weeks prior to startup, the Subs and vendors schedule startup and checkout with the GC, A/E, and CxA. The performance of the pre-functional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off pre-functional checklists, signatures may be required of other Subs for verification of completion of their work.
   2. The CxA may observe the procedures for each piece of primary equipment, the contractor shall provide two weeks advance notice to the CxA prior to commencing startup procedures.
   3. For lower-level components of equipment, (e.g., VAV boxes, sensors, controllers), the CxA shall observe a sampling of the pre-functional and startup procedures, at their discretion.
   4. The Subs and vendors shall execute startup and provide the CxA with a signed and dated copy of the completed startup and pre-functional tests and checklists.
   5. Only individuals that have direct knowledge and witnessed that a line item task on the pre-functional checklist was actually performed shall initial or check that item off. It is not acceptable for non-witnessing personnel to fill out these forms.
   6. Sampling strategies by the contractor are not acceptable for startup and pre-functional checklists.

F. Deficiencies, Non-Conformance and Approval in Checklists and Startup
   1. The Subs shall clearly list any outstanding items of the initial startup and pre-functional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CxA within two days of test completion.
   2. The CxA reviews the report and submits either a non-compliance report or an approval form to the GC. The CxA shall work with the Subs and vendors to correct and retest deficiencies or uncompleted items. The CxA will involve the GC and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected and resubmit an updated startup report and a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CxA recommends approval of the execution of the checklists and startup of each system to the GC using a standard form.
   3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party. Refer to Part 3.7 herein for details.

3.5 PHASED COMMISSIONING

A. The project may require startup and initial checkout to be executed in phases. This phasing will be planned and scheduled in a coordination meeting of the CxA, GC, Mechanical Contractor, TAB Contractor, Controls Contractor, Electrical Contractor, and other disciplines, as required. Results will be added to the master and commissioning schedule.

3.6 FUNCTIONAL PERFORMANCE TESTING

A. This sub-section applies to all commissioning functional testing for all divisions.

B. The general list of equipment to be commissioned is found in Section 017500, Part 1.7 and referenced Sections. Samples of the equipment and modes to be tested are found in Section 23 08 19 and other sections where tests requirements are found.

C. The parties responsible to execute each test are listed with each test in Sections XX 08 00 and other sections where test requirements are found.

D. Objectives and Scope: The objective of functional performance testing is to demonstrate that each system is operating according to the documented Owner's Project Requirements and Contract Documents. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested. Specific modes required in this project are given in Sections XX 08 00 and other sections where test requirements are found.

E. Development of Test Procedures: Before test procedures are written, the CxA shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements in Sections XX 08 00 and other sections where test requirements are found, the CxA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each Sub or vendor responsible to execute a test shall provide assistance to the CxA in developing the procedures review (answering questions about equipment, operation, sequences, etc.). Prior to execution, the CxA shall provide a copy of the test procedures to the Sub(s) who shall review the tests for feasibility, safety, equipment and warranty protection. The CxA may submit the tests to the A/E for review, if requested. The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.

F. Representative test formats and examples (not designed for this project) are found in the Section 23 08 19. The test procedure forms developed by the CxA shall include (but not be limited to) the following information:
   1. System and equipment or component name(s)
   2. Equipment location and ID number
   3. Unique test ID number, and reference to unique pre-functional checklist and start-up documentation ID numbers for the piece of equipment
   4. Date
   5. Project name
   6. Participating parties
   7. A copy of the specification section describing the test requirements
   8. A copy of the specific sequence of operations or other specified parameters being verified
   9. Formulas used in any calculations
   10. Required pre-test field measurements
   11. Instructions for setting up the test.

12. Special cautions, alarm limits, etc.
13. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable format
14. Acceptance criteria of proper performance with a Yes/No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved
15. A section for comments
16. Signatures and date block for the CxA

G. Test Methods

1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers. Sections XX 08 00 specify which methods shall be used for each test. The CxA may substitute specified methods or require an additional method to be executed, other than what was specified, with no additional cost to the Owner. The CxA will determine which method is most appropriate for tests that do not have a method specified.
2. Simulated Conditions: Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
3. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a heat gun, rather than overwriting the value or by altering the appropriate set point to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
4. Simulated Signals: Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
5. Altering Set points: Rather than overwriting sensor values, and when simulating conditions is difficult, altering set points to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55°F, when the outside air temperature is above 55°F, temporarily change the lockout set point to be 2°F above the current outside air temperature.
6. Indirect Indicators: Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during pre-functional testing.
7. Set-up: Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.
8. Sampling: Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. The specific recommended sampling rates are specified with each

type of equipment in Sections XX 08 00. It is noted that no sampling by Subs is allowed in pre-functional checklist execution.

a. A common sampling strategy referenced in the Specifications as the "xx% Sampling—yy% Failure Rule" is defined by the following example.
   1) xx = the percent of the group of identical equipment to be included in each sample.
   2) yy = the percent of the sample that if failing, will require another sample to be tested.

b. The example below describes a 20% Sampling—10% Failure Rule.
   1) Randomly test at least 20% (xx) of each group of identical equipment. In no case test less than three units in each group. This 20%, or three, constitute the "first sample."
   2) If 10% (yy) of the units in the first sample fail the functional performance tests, test another 20% of the group (the second sample).
   3) If 10% of the units in the second sample fail, test all remaining units in the whole group.
   4) If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxA may stop the testing and require the responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

H. Coordination and Scheduling: The Subs shall provide two (2) week notice to the CxA regarding their completion schedule for the pre-functional checklists and startup of all equipment and systems. The CxA will schedule functional tests through the GC. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.

I. In general, functional testing is conducted after pre-functional testing and startup has been satisfactorily completed. The control system shall be sufficiently tested and approved by the GC before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing is completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.

J. Test Equipment: Refer to Section 017500, Part 2 for test equipment requirements.

K. Problem Solving: The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the GC, Subs and A/E.

3.7 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

A. Documentation: The CxA shall witness and document the results of all functional performance tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the GC for review and approval and to the Subs for review. The CxA will include the filled out forms in the O&M manuals. Forms may be amended and modified by the CxA at any time with no additional cost to the Owner.

B. Non-Conformance:
   1. The CxA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the GC on the Commissioning Issues Log.
   2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form.
   3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not

be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the Owner.

4. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.
   a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
      1) The CxA documents the deficiency and the Sub's response and intentions and they go on to another test or sequence. After the day's work, the CxA reports the deficiency on the Commissioning Issues Log to the GC. A copy is provided to the Sub. The Sub corrects the deficiency, signs a statement of correction certifying that the equipment is ready to be retested and sends it back to the CxA.
      2) The CxA reschedules the test and the test is repeated.
   b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
      1) The deficiency shall be documented on Commissioning Issues Log with the Sub's response and a copy given to the GC and to the Sub representative assumed to be responsible.
      2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the CxA. Final acceptance authority is with the Project Manager and Owner.
      3) The CxA documents the resolution process.
      4) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CxA. The CxA reschedules the test and the test is repeated until satisfactory performance is achieved.
5. Cost of Retesting
   a. The cost for the Sub to retest a functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the GC.
   b. For a deficiency identified, not related to any pre-functional checklist or startup fault, the following shall apply: The CxA and GC will direct the retesting of the equipment once for a total of 8 hours maximum at no "charge" to the GC for their time. However, the CxA's and GC's time for a second retest or for retesting exceeding 8 hours will be charged to the GC, who may choose to recover costs from the responsible Sub.
   c. The time for the CxA and GC to direct any retesting required because a specific pre-functional checklist or startup test item, reported to have been successfully completed, but determined during functional testing to be faulty, will be back charged to the GC, who may choose to recover costs from the party responsible for executing the faulty pre-functional test.
   d. Refer to the sampling section of Section 017500, Part 3 for requirements for testing and retesting identical equipment.
6. The Contractor shall respond in writing to the CxA and GC within two weeks concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
7. Any required retesting by any contractor shall not be considered a justified reason for a claim of delay or for a time extension by the GC.

C. Failure Due to Manufacturer Defect: If 10%, or three, whichever is greater, of identical pieces (size or capacity alone does not constitute a difference) of equipment fail to perform to the

Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance requirements, all identical units may be considered unacceptable by the GC. In such case, the Contractor shall provide the Owner with the following:

1. Within one week of notification from the GC, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the GC within two weeks of the original notice.
2. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
3. The GC will determine whether a replacement of all identical units or a repair is acceptable.
4. Two examples of the proposed solution will be installed by the Contractor and the PM will be allowed to test the installations for up to one week, upon which the GC will decide whether to accept the solution.
5. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

D. Approval: The CxA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CxA and by the GC, if necessary. The CxA recommends acceptance of each test to the GC using a standard form. The GC gives final approval on each test using the same form, providing a signed copy to the CxA and the Contractor.

3.8 OPERATION AND MAINTENANCE MANUALS

A. Standard O&M Manuals

1. Initial Submittal: Submit four (4) Draft Copies of each manual no later than 150 days prior to substantial completion. Include a complete Operation and Maintenance directory. The Project Manager will return one (1) copy and mark whether general scope and content of manuals are acceptable.
2. Final Submittal: Submit six (6) copies of each manual in final format at least one hundred twenty (120) days prior to substantial completion. The GC will return one (1) copy with A/E comments within fourteen (14) days. Correct or modify each manual to comply with the comments made. Submit six (6) copies of each corrected manual within fourteen (14) days of receipt of A/E comments.
3. The specific content and format requirements for the standard O&M manuals are detailed in Section 013300 and the Owner requirements, in addition to specific equipment and system specifications.
4. A/E Contribution: The A/E will include in the beginning of the O&M manuals a separate section describing the systems including:
   a. The design intent narrative prepared by the A/E and provided as part of the bid documents, updated to as-built status by the A/E.
   b. Simplified professionally drawn single line system diagrams on 8 ½" x 11" or 11" x 17" sheets. These shall include cooling/heating systems, supply air systems, exhaust systems and heaters. These shall show major pieces of equipment.
5. CxA Review and Approval: The CxA shall review the O&M manuals, documentation and redline as-builts for systems that were commissioned and other systems documentation that the CxA should review, to verify compliance with the Specifications. The CxA will communicate deficiencies in the manuals to the GC or A/E, as requested. Upon a successful review of the corrections, the CxA recommends approval and acceptance of these sections of the O&M manuals to the GC or A/E. The CxA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly

stated. This work does not supersede the A/E's review of the O&M manuals according to the A/E's contract.

6. Refer to Section 017823 and equipment specific Sections for other O&M requirements.

3.9 TRAINING OF OWNER PERSONNEL

A. The GC shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed.

B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.

1. The GC shall interview the facility manager and lead engineer to determine the special needs and areas where training will be most valuable. The Owner and CxA shall decide how rigorous the training should be for each piece of commissioned equipment. The CxA shall communicate the results to the Subs and vendors who have training responsibilities.
2. In addition to these general requirements, the specific training requirements of Owner personnel by Subs and vendors is specified in Division 21, 22, 23, 26, 27 and 28, and other sections where training requirements are found.
3. Each Sub and vendor responsible for training will submit a written training plan to the CxA for review and approval two weeks prior to training. The plan will cover the following elements:
   a. Equipment (included in training)
   b. Intended audience
   c. Location of training
   d. Objectives
   e. Subjects covered (description, duration of discussion, special methods, etc.)
   f. Duration of training on each subject
   g. Instructor for each subject
   h. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)
   i. Instructor and qualifications
   j. A sign in sheet shall be provided for each training session and shall be furnished to the owner with the final O&M Manuals.
   k. A survey of training participants shall be included for each training session and provided to the Owner and CxA within two weeks of training sessions.
4. For the primary HVAC equipment, the Controls Contractor shall provide a discussion of the control of the equipment during the mechanical or electrical training conducted by others.
5. The CxA reviews the overall training plan and coordinates and schedules with the GC and Owner, the overall training for the commissioned systems. The CxA develops criteria for determining that the training was satisfactorily completed, including attending some of the training, etc. The CxA recommends approval of the training to the A/E using a standard form. The CM also signs the approval form.
6. Videotaping of all training sessions will be provided by the GC with CD's cataloged by the GC, and added to the O&M manuals.
7. The mechanical design engineer shall, at the first training session, present the overall system design concept and the design concept of each equipment section. This presentation shall include a review of all systems using the simplified system schematics (one-line drawings) including cooling/heating systems, supply air systems, exhaust system and outside air strategies.

3.10 DEFERRED TESTING

A. Unforeseen Deferred Tests: If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the GC. These tests will be conducted in the same

manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated

END OF SECTION 017500

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.

B. Related Requirements:

1. Division 01 Section "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
2. Division 01 Section "Photographic Documentation" for submitting Final Completion construction photographic documentation.
3. Division 01 Section "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
4. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
5. Division 01 Section "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.4 ACTION SUBMITTALS

A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

B. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.7 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of (10) days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Owner. Label with manufacturer's name and model number.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.

5. Submit testing, adjusting, and balancing records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of (10) days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.

2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of (10) days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.8 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Division 01 Section "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

a. Project name.
b. Date.
c. Name of Architect.
d. Name of Contractor.
e. Page number.

1.10 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit by uploading to web-based project software site.

E. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
l. Remove labels that are not permanent.
m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean ducts, blowers, and coils if units were operated during construction or that display contamination with particulate matter on inspection.
q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
r. Clean strainers.
s. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Division 01 Section "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste-disposal requirements in Division 01 Section "Construction and Demolition Waste Management and Disposal."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Division 01 Section "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 01 77 00

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:

1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Division 01 Section "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit on digital media acceptable to Architect or by uploading to web-based project software site. Enable reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Agent will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Agent will return copy with comments.

1. Correct or revise each manual to comply with Architect's and Commissioning Agent's comments. Submit copies of each corrected manual within 15 days of receipt of comments and prior to commencing demonstration and training.

E. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.4 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. General: Submit Final Manual electronically and provide (3) paper copies to the Owner.

B. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

C. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.5 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Architect.
7. Name and contact information for Commissioning Agent.
8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
9. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.6 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:

1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.7 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

    a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.

5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.

5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Samples.
3. Miscellaneous record submittals.

B. Related Requirements:

1. Division 01 Section "Closeout Procedures" for general closeout procedures.
2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal:

1) Submit PDF electronic files of scanned record prints.
2) Submit Record Digital Data Files.
3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit (1) paper-copy set of marked-up record prints.
2) Submit PDF electronic files of scanned record prints.
3) Submit Record Digital Data Files.
4) Print each drawing, whether or not changes and additional information were recorded.

B. Record Samples: Immediately prior to date of Substantial Completion meet with the Architect and the Owner's personnel at the site to determine which of the Samples maintained during the construction period shall be transmitted to the Owner for record purposes. Comply with the Architect's instructions for packaging, identification marking, and delivery to the Owner's Sample storage space. Dispose of other Samples in a manner specified for disposing surplus and waste materials.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an acceptable drawing technique.
c. Record data as soon as possible after obtaining it.
d. Record and check the markup before enclosing concealed installations.
e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or Construction Change Directive.
k. Changes made following Architect's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as for the original Contract Drawings.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect for resolution.

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

a. Project name.
b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Architect.
e. Name of Contractor.

1.5 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic files and scanned PDF electronic files of marked-up miscellaneous record submittals.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.6 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.

1.3 INFORMATIONAL SUBMITTALS

A. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.

2. Documentation: Review the following items in detail:

   a. Emergency manuals.
   b. Systems and equipment operation manuals.
   c. Systems and equipment maintenance manuals.
   d. Product maintenance manuals.
   e. Project Record Documents.
   f. Identification systems.
   g. Warranties and bonds.
   h. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.

k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning.
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner through, with at least seven days' advance notice.

C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

D. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 79 00

SECTION 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS – LEED

PART 1 - GENERAL

1.1 SUMMARY

A. This project is designed to achieve all Prerequisites and no less than 50 points under the US Green Building Council's LEED® v4 for Building Design and Construction (LEED BD+C: New Construction) Rating System for at least a LEED Silver-level rating. Throughout this section, the term LEED is used in place of LEED BD+C: New Construction.
   1. Certain LEED prerequisites and credits needed to obtain LEED certification are dependent on material selections. Compliance with LEED prerequisites and credits is a basis for evaluation of substitution requests.
   2. Additional LEED prerequisites and credits needed to obtain indicated LEED certification are dependent on Architect's design and other aspects of the Project that are not part of the Work of Contract.
   3. Substitute requirements for LEED v4.1 for the following credits.
      a. Integrated Process (IP) Credit 1: Integrated Process
      b. Location and Transportation (LT) Credit 3: High Priority Site
      c. LT Credit 5: Access to Quality Transit
      d. LT Credit 6: Bicycle Facilities
      e. LT Credit 7: Reduced Parking Footprint
      f. LT Credit 8: Green Vehicles (renamed Electric Vehicles)
      g. Sustainable Sites (SS) Credit 2: Site Development – Protect or Restore Habitat (renamed Protect or Restore Habitat)
      h. SS Credit 4: Rainwater Management
      i. Energy and Atmosphere (EA) Credit 5: Renewable Energy Production (renamed Renewable Energy)
      j. Materials and Resources (MR) Prerequisite 2: Construction and Demolition Waste Management Planning
      k. MR Credit 2: BPDO – Environmental Product Declarations (renamed Environmental Product Declarations)
      l. MR Credit 4: BPDO – Material Ingredients (renamed Material Ingredients)
      m. MR Credit 5: Construction and Demolition Waste Management
      n. Indoor Environmental Quality (EQ) Credit 1: Enhanced Indoor Air Quality Strategies
      o. EQ Credit 6: Interior Lighting

B. Refer to LEED Scorecard accompanying this Section for LEED Prerequisites and Credits pursued for this project.

C. LEED has no published numbering system. This project manual imposes a numbering system based on that created by LEEDUser©. This numbering system is indicated on the LEED Scorecard and utilized throughout these specifications.

D. LEED credit pursuit is subject to change at the discretion of the Owner, Architect, and Sustainability Consultant.

E. Contractor is responsible for all requirements of LEED Prerequisites and Credits that are contained throughout these specifications.

F. Contractor is not responsible for the application for LEED certification.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Division 01 Section “Construction and Demolition Waste Management and Disposal” for detailed LEED requirements to be incorporated into construction process.

B. Division 01 Section “General Commissioning Requirements” for detailed commissioning requirements.

C. Divisions 01 through 33: Sustainable requirements specific to the work of each of these Sections.

1.3 REFERENCES

A. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 52.2-2007: Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size

B. ASHRAE 62.1-2010, Sections 4–7, Ventilation for Acceptable Indoor Air Quality

C. ASHRAE/IESNA 90.1-2010 Final Qualitative Determination

D. American Society for Testing and Materials (ASTM) D5055-13: Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists

E. Cradle to Cradle (C2C) Certification

F. Cradle to Cradle (C2C) Material Health Certificate

G. Declare Product Database (International Living Future Institute)

H. EN 15804: Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

I. Federal Trade Commission (FTC), Guidelines for the Use of Environmental Marketing Claims – 16 CFR 260.7 (e)

J. Global Green TAG PHD

K. GreenScreen for Safer Chemicals

L. Invasive Plant Atlas of the United States

M. ISO Standard 14021-1999 – Environmental Labels and Declarations – Self-Declared Environmental Claims (Type II Environmental Labeling)

N. ISO Standard 14025-2006, Environmental Labels and Declarations – Type III Environmental Declarations – Principles and Procedures

O. ISO Standard 14040-2006, Environmental Management, Lifecycle Assessment Principles and Framework

P. ISO Standard 14044-2006, Environmental Management Lifecycle Assessment Requirements and Guidelines

Q. ISO Standard 14071-2014, Environmental Management – Lifecycle Assessment – Critical review processes and reviewer competencies

R. ISO Standard 21930-2007, Sustainability in Building Construction – Environmental Declaration of Building Products

S. ISO Standard 15118-1 Road vehicles — Vehicle to grid communication interface

T. Living Product Challenge

U. North American Terrestrial Ecoregions – Level III, April 2011

V. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) Indoor Air Quality Guidelines for Occupied Buildings under Construction, 2nd Edition, 2007, ANSI-SMACNA 008-2008, Chapter 3

W. Sustainable Agriculture Network's (SAN) Sustainable Agriculture Standard

X. United Nations Globally Harmonized System of Classification and Labelling of Chemicals (GHS)

Y. USDA Natural Resources Conservation Service, PLANTS Database

Z. US EPA Construction General Permit (CGP) 2012

AA. US EPA WaterSense Program

BB. US EPA ENERGY STAR Program

CC. United States Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) version 4 (LEED v4) Rating System and Reference Guide for Building Design and Construction (BD+C), with all current addenda

DD. USGBC LEED version 4.1 (LEEDv4.1) Rating System and Getting Started Guide for Building Design and Construction (BD+C), with selected addenda

EE. Xerces Society for Invertebrate Conservation, Pollinator-Friendly Plant Lists

1.4 DEFINITIONS

A. BROWNFIELD: Expansion, redevelopment, or reuse of real property, complicated by the presence or potential presence of a hazardous substance, pollutant or contaminant (Public Law 107-118, H.R. 2869, Small Business Liability Relief and Brownfield Revitalization Act).

B. BUILDING WATERPROOFING MEMBRANE: Includes materials which make up the complete waterproofing system for the building exterior.

C. BUILDING INTERIOR: Includes materials and products installed within the building waterproofing membrane but excluding the waterproofing membrane itself.

D. BUILDING EXTERIOR: Includes materials and products installed outside and inclusive of the primary and secondary waterproofing system, including air-resistive and water-resistive barrier materials.

E. COMMINGLED WASTE: Construction and demolition waste streams combined on-site and sorted off-site into recyclable streams. Also known as single-stream recycling.

F. ENVIRONMENTAL PRODUCT DECLARATION (EPD): Product disclosure conforming to ISO 14025, 14044, 14071, and EN 15804 or ISO 21930 with at least cradle to gate scope. Other criteria may apply depending upon selected standard compliance.

G. FURNITURE: Non-permanently affixed products that do not provide structural purpose and may be removed without damage to real property.

H. GREEN BUSINESS CERTIFICATION INSTITUTE (GBCI): Entity providing third-party project LEED certification and professional credentials recognizing excellence in green building performance and practice in support of the USGBC.

I. LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED): A voluntary green building rating system created and managed by the US Green Building Council (USGBC).

J. LEED ONLINE: GBCI project management tool where projects are registered, tracked, and submitted to GBCI for project certification. Information, resources, and support are made available to registered projects. Project team members can upload information to credit forms, submit LEED Interpretation (LI) requests, manage key project details, view and respond to reviewer comments.

K. MATERIAL COST VALUE: The dollar value of materials being provided to the project, after any contractor mark-ups and expense to deliver to the site, excluding equipment or labor costs.

L. MINIMUM EFFICIENCY REPORTING VALUE (MERV): Standard method for comparing the efficiency of an air filter, as defined in ASHRAE 52.2-2007. Scale ranges from 1 to 16, which 16 being the most efficient at removing particles from air.

M. PERMANENTLY INSTALLED PRODUCT: In addition to those items that serve structural purposes, permanently installed products are items that are affixed without intention to be removed, either because the item is integral to the walls, ceiling, or floor, or removing the item will cause damage to the building.

N. RECYCLING: Collection, reprocessing, marketing and use of materials that were recovered or diverted from solid waste stream.

O. REGULARLY OCCUPIED SPACE: Enclosed area where people normally spend time, defined as more than one hour of continuous occupancy per person per day, on average; the occupants may be seated or standing as they work, study, or perform other activities. For spaces that are not used daily, the one-hour timeframe should be based on the time a typical occupant spends in the space when it is in use.
   1. DENSELY OCCUPIED SPACE: A design occupant density of 25 people or more per 1,000 square feet (93 square meters), or 40 square feet (3.7 square meters) or less per person.
   2. INDIVIDUAL OCCUPANT SPACE: An area where someone performs distinct tasks.
   3. MULTIOCCUPANT SPACE: A place of congregation or a place where people pursue overlapping or collaborative tasks.

P. SALVAGE: Removal of existing materials or assemblies for re-installation or other use.

Q. WASTE: Extra material or material that has reached end of its useful life in its intended use.

1.5 CONTRACTOR LEED COORDINATOR ROLE

A. Designate one employee or consultant as the Contractor LEED Coordinator for this Project.
   1. Maintain access to LEED Online at project award and throughout project.
   2. Oversee the sustainable building activities for the project.
   3. Instruct workers concerning the sustainable building goals.
   4. Be present on site on a regular basis when Work is in progress.
   5. Prepare and oversee all LEED related submittals.
   6. Document all credits assigned to the Contractor.
   7. Attend all LEED meetings.
   8. Complete final LEED documentation including LEED online construction credits.

B. Contractor is responsible for completion and transmittal of all construction-related documentation required for LEED certification.
   1. Submit for approval information demonstrating LEED compliance.
   2. Highlight or circle pertinent LEED information within each submittal.
   3. Include LEED Submittal Form as the first page of the submittal. This form is provided at the end of this section.

C. Contractor is responsible for submitting and installing products in accordance with the Sustainable Design Requirements outlined as well as:
   1. LEED SUBMITTAL FORM: All project submittals shall be accompanied by a completed LEED coversheet. Submittal packages shall also include documentation in support of the sustainability claims made on the LEED coversheet, including:
      a. Name of manufacturer
      b. Model number for each material or product
      c. Indicate documents included within submittal package
   2. Contractor to maintain Building Products Calculator and Construction and Demolition Waste Management Calculator monitoring the project’s progress regarding Materials and Resources goals. Calculators to be presented at construction meetings.

D. Contractor shall complete documentation on the LEED Online Project Database. Assemble the LEED Submittal files in electronic format throughout project construction and organized per LEED credit (see Part 1 CLOSEOUT SUBMITTALS for LEED Online). Documentation includes:
   1. One consolidated electronic (Excel) copy:
      a. Building Products Calculator
      b. Construction and Demolition Waste Management Calculator
   2. Electronic (PDF) copies:
      a. Waste Management Plan(s)
      b. Construction Indoor Air Quality Management Plan
      c. Cut sheets
      d. Material Transparency declarations and reports
      e. Photographs and any other required information

E. Contractor shall respond to questions and requests from GBCI about LEED prerequisites and credits that are the Contractor's responsibility, that depend on product selection or product qualities, or that depend on Contractor's procedures until GBCI and USGBC have made their determination on Project's LEED certification application.

1.6 CONSTRUCTION MEETINGS

A. Pre-construction Conference: Contractor will schedule a LEED coordination conference at a time convenient to Owner, Architect, Sustainability Consultant, and Contractor.
   1. Attendees: Authorized representatives of Owner, Architect, Sustainability Consultant, Contractor Representatives (including LEED Coordinator), and other concerned parties as appropriate.
   2. Agenda: Discuss items of significance that could affect meeting LEED requirements, including the following:
      a. LEED Scorecard and required certification level
      b. Role of Contractor's LEED Coordinator
      c. General requirements for LEED-related procurement and documentation, including the LEED submittal review process
      d. Erosion and sedimentation control
      e. Commissioning participation and coordination
      f. Construction waste management
      g. Indoor air quality management
      h. Project closeout requirements and LEED certification procedures

B. Include the status of LEED-related work on the agenda of all regularly scheduled job-site meetings.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances and regulations of Federal, State and Municipal authorities having jurisdiction. Obtain necessary approvals from all such authorities.

B. Environmental claims must comply with FTC Guidelines for the Use of Environmental Marketing Claims.

C. EQ Credit 3: Construction IAQ Management

1. Coordinate maintaining indoor air quality during construction with all trades involved in the construction project. Give special attention to the sequencing of work to protect materials and safeguard the well-being of the construction staff in accordance with the Construction IAQ Management Plan.

1.8 PRELIMINARY SUBMITTALS

A. Within 60 days of contract award, submit qualifications for designated Contractor LEED Coordinator:
   1. Option 1 - Demonstrate experience on at least one LEED Certified project.
   2. Option 2 - LEED Green Associate or Accredited Professional (AP) with specialty.

B. Prior to any waste removal and in advance of the Pre-Construction Meeting, submit for approval a detailed Waste Management Plan in accordance with LEED MR Prerequisite 2 and Credit 5 requirements and as outlined in Section 017419 "Construction and Demolition Waste Management and Disposal."

C. Within 90 days of contract award, based upon the LEED scorecard, submit for approval plans to demonstrate the contractor's approach to the following:
   1. MR Credits 2 and 4: Preliminary LEED Building Products (BP) Calculator indicating that credit requirement(s) will be met based on identified materials.
      a. MR Credit 2: Environmental Product Declarations (EPD)
         1) Option 1 – Environmental Product Declaration
      b. MR Credit 4: Material Ingredients
         1) Option 1 – Material Ingredient Reporting
   2. EQ Credit 3: Construction Indoor Air Quality (IAQ) Management
      a. Preliminary plan or checklist: Demonstrate all applicable control measures of Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) Indoor Air Quality Guidelines for Occupied Buildings under Construction, 2nd Edition, 2007, ANSI-SMACNA 008-2008, Chapter 3.

1.9 ACTION SUBMITTALS

A. SS Credit 2: Protect or Restore Habitat
   1. Provide confirmation that all imported soils meet criteria listed in Part 2 of this Section.

B. SS Credit 5: Heat Island Reduction
   1. Provide manufacturer product data indicating three-year aged or initial Solar Reflectance (SR) for non-roof materials and three-year aged or initial Solar Reflectance Index (SRI) for roof surface materials.

C. SS Credit 6: Light Pollution Reduction
   1. Exterior luminaires: Product data indicating Backlight, Uplight, and Glare (Forward Light) ratings (BUG).

D. WE Prerequisite 2 and Credit 2: Indoor Water Use Reduction
   1. Provide confirmation of EPA WaterSense compliance for the following plumbing fixtures.
      a. Tank-type water closets
      b. Urinals
      c. Showerheads and aerators

2. Provide flush rates in gallons per flush for urinals and water closets.
3. Provide flow rates in gallons per minute for showerheads, lavatory faucets, handwash sink faucets, kitchen sink faucets and prerinse spray valves.
4. Provide confirmation of ENERGY STAR compliance for the following appliances.
   a. Residential dishwashers (standard and compact)

E. EA Prerequisite 4: Fundamental Refrigerant Management
1. Heating, ventilating, air-conditioning, and refrigeration (HVAC&R) equipment, commercial refrigerators, freezers, ice makers, and water coolers: Product data for refrigerant listed in pounds.

F. EA Credit 3: Advanced Energy Metering
1. Product data indicating data storage capabilities.

G. MR Credit 2: Environmental Product Declarations, Option 1
1. Option 1 – EPD: Minimum 40 declarations from at least five different manufacturers meeting criteria listed in Part 2 ENVIRONMENTAL PRODUCT DECLARATION.

H. MR Credit 4: Material Ingredients
1. Option 1 – Material Ingredients Reports: Minimum 40 reports from at least five different manufacturers demonstrating compliance with criteria described under Part 2 MATERIAL INGREDIENT REPORTS.

I. EQ Credit 1: Enhanced Indoor Air Quality Strategies
1. Product data indicating MERV rating of final filtration media.
2. For wall-mounted carbon dioxide sensors: Documentation indicating accuracy in percent.

J. Innovation (IN) Credit 1: Reduced Mercury in Lamps
1. Product data for all LED and mercury-containing lamps, indicating mercury content in milligrams, mean lumen output, and lamp life in hours.

K. INFORMATIONAL SUBMITTALS

L. SS Prerequisite 1: Construction Activity Pollution Prevention
1. Provide periodic inspection reports or date-stamped photographs demonstrating the erosion and sedimentation control plan measures in compliance with the 2012 US Environmental Protection Agency (EPA) Construction General Permit (CGA) or local equivalent.
   a. Include maintenance activities during construction.

M. EA Credit 5: Renewable Energy
1. Provide documentation showing total annual production of solar array.

N. With each Application for Payment, submit Construction and Demolition Waste Management Calculator and progress reports for waste disposed, diverted and/or salvaged to date. Demonstrating compliance with MR Credit 5.
1. Refer to Section 017419 “Construction and Demolition Waste Management and Disposal.”

O. With each Application for Payment, submit progress reports using the Building Products Calculator for procured or approved contributing materials to date. Include product name and all information pertaining to credit compliance and contribution.
   1. MR Credit 2: Environmental Product Declarations
   2. MR Credit 4: Material Ingredients

P. EQ Credit 3: Construction IAQ Management
   1. Product data indicating MERV rating of temporary and final filtration media.
      a. Include dates and locations of all filter replacement installations.
   2. Provide date-stamped photographs from at least three different periods of time during construction demonstrating the implementation of SMACNA measures, annotation of measure in place, and general location of the photograph.
      a. Alternative: Narrative demonstrating how the IAQ Plan was implemented and describing the protection of materials from moisture damage.

1.10 CLOSEOUT SUBMITTALS

A. LEED Online: At completion of construction and prior to contract closeout, complete the LEED Online Form, upload the associated required documentation to the LEED Online Project Database, and respond to GBCI preliminary review comments.
   1. SSp1: Construction Activity Pollution Prevention
   2. MR Prerequisite 2 and Credit 5: Construction and Demolition Waste Management
   3. MR Credit 2: Environmental Product Declarations
   4. MR Credit 4: Material Ingredients
   5. EQ Credit 3: Construction IAQ Management Plan

PART 2 - PRODUCTS

2.1 IMPORTED SOILS

A. Provide imported soils complying with the following criteria:
   1. Not classified as prime farmland, unique farmland or farmland of statewide or local importance
   2. Not extracted from a greenfield site
   3. Not sphagnum peat moss

2.2 HEAT ISLAND EFFECT – ROOF SURFACE MATERIALS

A. Solar Reflectance Index (SRI) for roof surface materials:
   1. Low-sloped Roofs: Minimum 0.82 initial SRI; or minimum 0.64 for three-year aged SRI.

2.3 HEAT ISLAND EFFECT – NONROOF SURFACE MATERIALS

A. Solar Reflectance (SR) for shading device surface material: Minimum 0.33 initial SR; or minimum 0.28 for three-year aged SR.

B. Solar Reflectance (SR) for exterior paving surface materials: Minimum 0.33 initial SR; or minimum 0.28 for three-year aged SR.

2.4 INTERIOR LIGHTING

A. Lighting Controls: Multi-level or dimmable capabilities.

2.5 EXTERIOR LIGHTING

A. Backlight, Uplight and Glare (OR Forward Light) Rating: Maximum based on SSc6 Light Pollution Reduction Tables 1-4 in the LEED Reference Guide.

2.6 PLUMBING FIXTURES AND APPLIANCES

A. Residential dishwashers (standard and compact): ENERGY STAR compliant.

B. Tank-type water closet, urinal and showerhead and aerator: WaterSense Labeled.

2.7 ENVIRONMENTAL PRODUCT DECLARATION (EPD)

A. Where indicated, provide permanently installed products with one of the following declarations for at least cradle to gate scope.
   1. Product-specific declaration that is publicly available, critically reviewed life-cycle assessment (LCA) conforming to ISO 14044: Contribute to LEED MR credit calculations as one (1) product.
   2. Environmental Product Declaration: Conform to ISO 14025, and to Product Category Rules (PCR) standard EN 15804 or ISO 21930:
      a. Industry-wide Type III EPD, with third party certification including external verification in which the manufacturer is recognized as participant by the program operator: Contribute to LEED MR credit calculations as one (1) product.
      b. Product-specific Type III EPD internally reviewed with LCA in accordance with ISO 14071: Contribute to LEED MR credit calculations as one (1) product.
      c. Product-specific Type III EPD with third-party certification and externally reviewed with LCA: Contribute to LEED MR credit calculations as one and one-half (1.5) product.

2.8 MATERIAL INGREDIENT REPORTS

A. Where indicated, provide permanently installed products that demonstrate at least one of the following chemical inventory programs to at least one tenth percent (0.1%) or 1000 parts per million (ppm) of the end use product:
   1. Published manufacturer content inventory demonstrating one of the following.
      a. Publicly available inventory of all ingredients identified by name and Chemical Abstract Service Registration Number (CASRN).
      b. Materials defined as trade secret of intellectual property: Disclose role, amount and hazard screen using one of the following:
         1) Greencreen List Translator score or GreenScreen benchmark as defined in GreenScreen version 1.2
         2) Globally Harmonized System (GHS) of Classification and Labeling Chemicals revision 6 (2015). Hazard screen must be applied to each trade secret ingredient and the inventory lists the hazard category for each of the health hazards included in Part 3 of GHS.
   2. Health Product Declaration (HPD): Demonstrate full disclosure of known hazards in compliance with the HPD Open Standard and published in the HPD Public Repository.
   3. Cradle to Cradle Material Health Certificate

4. Cradle to Cradle version 3 Certification with Material Health achievement Bronze level or higher
5. Declare Product Label for one of the following:
   a. Red List Free
   b. LBC Red List Free
   c. Declared
   d. Living Product challenge or LBC Compliant (also known as LBC Red List Approved): Demonstrate compliance for content inventory to 1000 parts per million (0.1%).
6. UL's Product Lens Certification
7. ACT's Facts Certification (NSF /ANSI 336-2011): Any certification level.
8. Global Green TAG PHD label issued after January 1, 2020.

B. Material ingredient reports with third-party verification including verification of content inventory: Contribute to LEED MR credit calculations as one and a half (1.5) products.

2.9 AIR FILTRATION MEDIA

A. Temporary filtration media: Filtration media rated for minimum efficiency reporting value (MERV) of 8 minimum, when tested in accordance with ASHRAE 52.2-2007.
   1. Alternative Compliance Path (ACP): Provide Class F5 or higher filtration media, in accordance with CEN Standard EN 779–2002.

B. Permanent filtration media for each ventilation system that supplies outdoor air to occupied spaces: Filtration media rated for minimum efficiency reporting value (MERV) of 13 minimum when tested in accordance with ASHRAE 52.2-2007.
   1. Alternative Compliance Path (ACP) Provide Class F7 or higher filtration media, in accordance with CEN Standard EN 779–2002.

PART 3 - EXECUTION

3.1 GENERAL

A. Incorporate procedures and processes during Construction and prior to occupancy as described herein.

B. Provide and enforce Construction Indoor Air Quality Plan for all construction activities within the building.

3.2 HVAC PROTECTION

A. If permanent HVAC is used during construction: Use filtration media at each return air grill. All HVAC systems, equipment and pathways to be dust and particulate free at time of substantial completion of that phase of construction, in accordance with SMACNA "IAQ Guidelines for Occupied Buildings Under Construction."
   1. Begin construction ventilation after building is substantially enclosed.
   2. Inspect filtration monthly and replace as needed with new MERV 8 filtration media throughout the HVAC system.
   3. Install new filtration media throughout the HVAC system after final phase of construction.

B. Keep HVAC system clean, free of dust, debris**,** moisture, gaseous and microbial contamination during storage, handling, installation and punch-out. Inspect all air inlets, air outlets, grilles, diffusers, plenums, and ducts upon completion of work.
   1. Cover and protect (taped plastic or similar method) all exposed air inlet and outlet openings, grilles, ducts, plenums, to prevent water, moisture, dust and other contaminate intrusion.
   2. Apply protection immediately after installation of equipment and ductwork.
   3. Protect at end of each work day duct runs that require more than a single day to install.
   4. Check and repair leaks in return ducts and air handlers.
   5. Do not use mechanical rooms for construction storage.
   6. Cleaning of ductwork is not part of this contract; however, if Contractor fails to protect ducts and equipment from construction pollutants as specified, provide ductwork cleaning at Contractor's cost.

C. Install all ceiling tiles prior to HVAC use if an un-ducted plenum must be used over a construction zone.

3.3 SOURCE CONTROL

A. Prohibit smoking (including use of electronic cigarettes) within the building and within 25 feet (2.5 meters) of building entrances, operable windows, or outdoor-air intakes.

B. Limit use of fossil-fueled temporary heating units to propane-powered only inside the building and near building entrances, windows and intakes and within 25 feet of building entrances, operable windows, or outdoor-air intakes.

C. Provide direct exhaust to the exterior during use of fossil-fueled temporary heating units and installation of strong emitting materials, including touch-up activities.
   1. Protect intakes and occupied spaces from exhaust.

D. Protect "absorptive" or dry sink materials from exposure to dust, debris and moisture contamination during product delivery, storage and handling from construction, demolition and punch-out activities.

E. Provide adequate ventilation of packaged dry products prior to installation.

F. Prohibit "bake-out" or "super-heating" of spaces to accelerate the release of gaseous emissions.

3.4 PATHWAY INTERUPTION

A. Relocate pollutant sources when project equipment or staging areas coincide with critical air flow pathways.

B. Place barriers to contain construction areas.

C. Temporarily seal building, including air intakes and exhaust vents, and any other building openings, when dust-generating or strong-emitting construction products or procedures are used on the exterior of the building.

D. Once spaces within building become occupied, work areas must remain under negative pressure. Exhaust air at a rate at least 10 percent greater than the rate of supply.
   1. Do not exhaust air where it can be drawn back into occupied spaces.
   2. Place continuous plastic barriers creating a seal between construction areas and occupied spaces.

3.5 HOUSEKEEPING

A. Clean floors regularly to keep dust from accumulating during construction and demolition.

B. Remove debris from building daily and suppress dust during construction and demolition activities with wetting agents or sweeping compounds.

C. Prior to use of return air ductwork without intake filters, clean and remove dust and debris generated by construction activities.

D. Use HEPA-filter vacuum throughout for final detailed cleaning.

E. Remove spills or excess application of solvent-containing products when discovered.

F. Keep work areas as dry as possible. Replace any absorptive (dry sink) material that is exposed to moisture.

3.6 SCHEDULING

A. Coordinate construction activities to minimize or eliminate disruption of operations in occupied portions of building.

B. Schedule for storage, installation, and protection of all components of air distribution systems.

C. Schedule for storage, installation, and protection of absorptive materials (woven, fibrous or porous, such as carpet, ceiling tiles, insulation, and fabrics) from exposure to emissions during and after installation from materials and finishes with potential for short-term release of off-gassing volatile organic compounds.
   1. Highlight critical methods used to protect absorptive materials from airborne pollutants such as dust, debris, moisture, gaseous and microbial contamination.
   2. Sequence installation of absorptive materials after odor-emitting activities have occurred and have been mitigated by ventilation.

D. Do not store absorptive materials on-site if protection measures as described above cannot be ensured.

3.7 ATTACHMENTS

A. LEED Scorecard

B. LEED Submittal Form

END OF SECTION 01 81 13

LEED v4.0 & v4.1 BD+C: New Construction

Project Scorecard

New Wilkens Police Precinct

Murphy & Dittenhafer Architects
6/20/2025

Project Information Form

Y	?Y	?N	N			
Y				PIf1	Project Information	

Integrative Process — Possible Points 1

Y	?Y	?N	N				
1				IPc1	Integrative Process	[v4.1]	1

Location and Transportation — Possible Points 16

Y	?Y	?N	N				
				LTc1	LEED for Neighborhood Development Location		16
2				LTc2	Sensitive Land Protection +1	[RP]	1
2				LTc3	High Priority Site and Equitable Development	[v4.1]	2
1			4	LTc4	Surrounding Density and Diverse Uses	[RP]	5
1			4	LTc5	Access to Quality Transit	[v4.1]	5
1				LTc6	Bicycle Facilities	[v4.1]	1
1				LTc7	Reduced Parking Footprint	[v4.1]	1
1				LTc8	Electric Vehicles	[v4.1]	1

Sustainable Sites — Possible Points 10

Y	?Y	?N	N				
Y				SSp1	Construction Activity Pollution Prevention		
1				SSc1	Site Assessment		1
3				SSc2	Protect or Restore Habitat +1	[v4.1] [RP]	2
			1	SSc3	Open Space	[v4.1]	1
			4	SSc4	Rainwater Management +1	[v4.1] [RP]	3
			2	SSc5	Heat Island Reduction		2
1				SSc6	Light Pollution Reduction		1

Water Efficiency — Possible Points 11

Y	?Y	?N	N				
Y				WEp1	Outdoor Water Use Reduction		
Y				WEp2	Indoor Water Use Reduction		
Y				WEp3	Building-Level Water Metering		
2				WEc1	Outdoor Water Use Reduction		2
5			1	WEc2	Indoor Water Use Reduction		6
			2	WEc3	Optimize Process Water Use	[v4.1]	2
2				WEc4	Water Metering +1	[RP]	1

Energy and Atmosphere — Possible Points 33

Y	?Y	?N	N		
Y				EAp1	Fundamental Commissioning and Verification
Y				EAp2	Minimum Energy Performance
Y				EAp3	Building-Level Energy Metering
Y				EAp4	Fundamental Refrigerant Management

Energy & Atmosphere, cont.

Y	?Y	?N	N				
3			3	EAc1	Enhanced Commissioning	[RP]	6
9	6		3	EAc2	Optimize Energy Performance		18
1				EAc3	Advanced Energy Metering		1
			2	EAc4	Grid Harmonization	[v4.1]	2
5				EAc5	Renewable Energy	[v4.1]	5
			1	EAc6	Enhanced Refrigerant Management		1

Materials and Resources — Possible Points 13

Y	?Y	?N	N				
Y				MRp1	Storage & Collection of Recyclables		
Y				MRp2	Construction and Demolition Waste Management Planning		
			5	MRc1	Building Life-Cycle Impact Reduction	[v4.1]	5
1			1	MRc2	Environmental Product Declarations	[v4.1]	2
			2	MRc3	Sourcing of Raw Materials	[v4.1]	2
1			1	MRc4	Material Ingredients	[v4.1]	2
2				MRc5	Construction and Demolition Waste Management		2

Indoor Environmental Quality — Possible Points 16

Y	?Y	?N	N				
Y				EQp1	Minimum IAQ Performance		
Y				EQp2	Environmental Tobacco Smoke Control		
2				EQc1	Enhanced Indoor Air Quality Strategies		2
			3	EQc2	Low-Emitting Materials	[v4.1]	3
1				EQc3	Construction Indoor Air Quality Management Plan		1
			2	EQc4	Indoor Air Quality Assessment	[v4.1]	2
1				EQc5	Thermal Comfort		1
1			1	EQc6	Interior Lighting	[v4.1]	2
			3	EQc7	Daylight	[v4.1]	3
			1	EQc8	Quality Views	[v4.1]	1
			1	EQc9	Acoustic Performance	[v4.1]	1

Innovation — Possible Points 6

Y	?Y	?N	N			
1				INc1.1	Pilot: Social Equity in Community	1
1				INc1.2	Purchasing: Lamps	1
1				INc1.3	Green Education	1
1				INc1.4	O+M	1
1				INc1.5	Design for active occupants	1
1				INc2	LEED Accredited Professional	1

Total — Possible Points 110

57	6		47

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110 points

[RP] - Regional Priority credit (adds 1 point)
[v4.1] - LEED v4.1 Credit Substitution

Design Credits/Construction Credits

LEED SUBMITTAL FORM

PROJECT NAME:	
Subcontractor Name:	
Sub's Point of Contact:	
CSI Section Number:	
Date:	
Submittal Number:	

INSTRUCTIONS:

1. Product-specific requirements are found in the CSI Specification. All columns may not be applicable to this project.
2. List each product on a separate row for products subject to LEED review in this package.
3. Product Cost ($) is required where indidcated with a $.
4. Mark with "X" the documents included in the submittal.

List all products in submittal below			ALL MATERIALS															
Manufacturer - Product Name		*Submittal Page Number*	$ PRODUCT COST	ENVIRONMENTAL PRODUCT DECLARATION (1)	EMBODIED CARBON OPTIMIZATION (12)					MATERIAL INGREDIENT REPORT (6)	MATERIAL INGREDIENT OPTIMIZATION (13)	OTHER (14)						
Ex. SW	*ProMar 200 Zero*	*XX*	*$XXX,XXX*	*X*	*X*					*X*	*X*	*X*						
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ADDITIONAL INFORMATION:

NOTES:

(1) See articles titled "Definitions" & "Environmental Product Declaration (EPD)" in Part 1 of Section 018113.

(6) See article titled "Material Ingredient Reports" in Part 1 of Section 018113.

(12) See article titled "Environmental Product Declaration (EPD)" in Part 1 of Section 018113.

(13) See article titled "Material Ingredients" in Part 1 of Section 018113.

(14) Include information for credits LTc8, SSc5, SSc6, WEp2/c2, EAc3, EAc4, EAc5, EAp4/c6, EQc1, EQc4, EQc6, EQc7, or Innovation Credits.

SECTION 02 41 13 - SELECTIVE SITE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Baltimore County Department of Public Works Standard Specifications for Construction and Materials, dated February 2007 and as amended.

C. Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials, dated July, 2023 and as amended.

1.2 DESCRIPTION

A. This Section includes the following:

1. Furnish all labor, materials, tools, equipment and services necessary for and reasonably incidental to complete the selective demolition work as indicated on the drawings or specified.

2. General intent of selective demolition work is indicated on drawings and described herein.

B. Related Sections:

1. Division 1 Section “Summary of Work” for use of the building and phasing requirements.
2. Division 2 Section “Selective Structure Demolition” for cutting and patching procedures for selective demolition operations.
3. Division 1 Section “Construction Progress Documentation” for demolition schedule requirements.
4. Division 1 Section “Temporary Facilities and Controls” for temporary utilities, temporary construction and support facilities, temporary security and protection facilities, and environmental protection measures for selective demolition operations.
5. Division 1 Section “Construction Waste Management and Disposal” for LEED requirements relating to demolition.
6. Division 1 Section “Sustainable Design Requirements” for LEED requirements relating to demolition.
7. Division 32 Section “Planting” for protecting trees remaining on-site.
8. Division 31 Section “Site Clearing” for site clearing and removing above, and below, grade improvements.
9. Division 31 Section “Excavation and Filling” for soil materials, excavating, backfilling, and site grading.
10. Division 23 Sections for cutting, patching, or relocating mechanical items.
11. Division 26 Sections for cutting, patching, or relocating electrical items.

1.3. OWNERSHIP OF REMOVED MATERIALS

A. Prior to Notice to proceed, Owner will remove all equipment, material and fixtures he wishes to retain. After which, all equipment, material and fixtures become the property of the Contractor to be removed from the premises and disposed of by him and legally disposed of offsite.

1.4. JOB CONDITIONS

A. Demolition Phasing

1. The contractor shall prepare and submit a demolition/construction staging plan to Baltimore County Property Management for approval prior to beginning any construction.

B. Condition of Structures: Owner assumes no responsibility for actual condition of structures to be demolished.

1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner insofar as practicable. However, variations within structure may occur by Owner's removal and salvage operations prior to start of demolition work.

C. Salvage Materials: Items of salvable value to Contractor may be removed from structure as work progresses. Transport salvaged items from site as they are removed.

1. Storage or sale of removed items will not be permitted on site.
2. Owner's salvage list will be provided at Pre-Bid Meeting.

D. Explosives: Use of explosives will not be permitted.

E. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

F. Protections: Ensure safe passage of persons around area of demolition. Conduct operations to prevent damage to adjacent buildings, structures, and other facilities and injury to persons.

G. Damages: Promptly repair damages caused to adjacent facilities by demolition operations.

H. Utility Services: Maintain existing utilities indicated to stay in service and protect against damages during demolition operations.

1. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

I. Utility Services: Refer to Division 23 and 26 sections for disconnecting, removing, and capping of utility services. Do not start demolition work until utility disconnections have been completed and verified in writing.

1.5 REGULATIONS

A. All work shall comply with the rules and regulations of Occupational Safety and Health Administration and all other Federal, State and County agencies and authorities having jurisdiction.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

3.1. PROTECTION OF PERSONS AND PROPERTY

A. Provide barricades, fences and other means of protection, in compliance with Federal, State and County safety regulations.

B. Provide protection for property adjacent to area of demolition.

C. Protect from damage against existing surfaces or materials to remain in place during demolition. Protect with suitable coverings when necessary. Any surfaces or materials to remain that are damaged during demolition shall be repaired or replaced by Contractor at no cost to the Owner.

D. Protect existing underground utilities during demolition operations. Call “Miss Utility” (800-257-7777) at least 48 hours prior to starting work. Perform necessary test pits as required to complete the project. Existing utilities damaged during demolition operations shall be repaired at no cost to the Owner.

E. Rubbish and debris shall be constantly sprinkled to lay the dust. All possible precautions shall be exercised to protect against dust and noise as required by local authorities. Rubble and debris resulting from demolition shall be removed from the site daily.

3.2. EXISTING SITE IMPROVEMENTS DEMOLITION

A. Existing Subsurface Conditions: Verify existing conditions of each respective site during pre-bid inspection. Obtain written authorization from the Owner before conducting test hole explorations of existing pavements within the project site. Conditions existing during pre-bid inspections will not be altered or modified.

B. Miscellaneous: Demolish additional miscellaneous existing site improvements indicated, specified and required to construct project.

3.3 EXISTING UNDERGROUND UTILITY DEMOLITION

A. Excavate and expose existing underground utilities and related structures designated for, or as required to implement, removals. For excavation operations refer to Section 312300 – Excavating and Filling. Remove existing utility structure castings. Backfill excavations, upon completion of utility demolition operations. For backfill operations refer to Section 312300 – Excavation and Filling.

END OF SECTION

SECTION 02 41 16 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of buildings and site improvements.
2. Disconnecting, capping, or sealing, and removing site utilities.
3. Salvaging items for reuse by Owner.
4. Note Owner coordination of Fiber Optic Lines on north property edge.

1.2 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

2. Salvage List, see below.

1.3 PREINSTALLATION MEETINGS

A. Pre-demolition Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Engineering Survey: Submit engineering survey of condition of building.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of building demolition activities with starting and ending dates for each activity.

D. Pre-demolition photographs or video.

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

1.5 CLOSEOUT SUBMITTALS

A. Inventory of items that have been removed and salvaged.

1.6 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

1.7 FIELD CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. See phasing plan and Summary of Work 01 10 00

C. Hazardous Materials: See Hazardous Materials Reports attached in Appendix and spec section 02 81 00 – Transportation and Disposal of Hazardous Materials.

1. The Contractor is responsible for the proper removal of hazardous materials.

2. All hazardous materials abatement packaging, transport, and disposal must be performed in strict compliance with all applicable local, state, and federal regulations, latest edition. The Contractor must maintain all licenses and certifications, in accordance with these regulations, which must be current for the entire term of this agreement.

D. On-site storage or sale of removed items or materials is not permitted.

E. Arrange demolition schedule so as not to interfere with Owner's on-site operations.

1.8 SALVAGED ITEMS FROM EXISTING BUILD

A. Historic items and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

2. Salvage List:
   a. All gun unloading stations / bullet traps are to be packed and transported into new facility from the existing facility.
   b. A gun safe is to be packed and transported into new facility from the existing facility.
   c. Memorial Stones / Plaques from the memorial garden are to be packed and provided to owner for storage.
   d. Prescription Drug Drop Box is to be packed and transported into new facilities from the existing facilities.
   e. 3’ X 4’ metal Police Department sign located on the chain-link fence is to be packed. Coordinate with Police to relocate off-site.
   f. Trane condensing unit – after phase 1 is completed is to be packed and palleted and transported off-site. Coordinate with Maintenance to relocate off-site.

g. Kohler generator and transfer panel - after phase 1 is completed is to be packed and palleted and transported off-site. Coordinate with Maintenance to relocate off-site.
h. “1961” engraved stone by the existing entrance to incorporate into the new memorial garden is to be packed and provided to the owner.
i. (20) bricks to be incorporated into the new memorial garden are to be wrapped in paper and packed in boxes.
j. 10” tall metal Police letters and Baltimore County insignia at the existing front entrance are to be packed and transported. Coordinate with Police to relocate off-site to BC Police Museum.
k. “Liberty” gun safe located in the Annex building to be packed and transported into the new facility.
l. “Veeder Root” leak detection system, is to be disconnected and all components are to be packed and provided to the owner – Coordinate with Maintenance to remove off-site.
m. Existing gym equipment including (1) treadmill, (2) stair climbers, (1) universal machine, (1) leg press machine and all plates – Coordinate with Police to either relocate off-site or re-use at the new facility.
n. 2’ x 3’ metal safe located in the Captain’s Office to be packed and relocated to the Captain’s Suite in the new facility.
o. Fingerprint machine and stand to be packed and transported into new facility from existing facility.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

2.2 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Section 31 20 00 "Earth Moving."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

B. Inventory and record the condition of items to be removed and salvaged.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

B. Salvaged Items: Comply with the following:

1. Clean salvaged items of dirt and demolition debris.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.

1. Owner will arrange to shut off utilities when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
4. Cut off pipe or conduit a minimum of 24 inches (610 mm) below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
5. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.
6. Fiber Optic Line Relocation to be performed by owner. See TA Low Voltage site plan drawings for work in contract.

3.4 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations.

B. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.

C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 01 50 00 "Temporary Facilities and Controls."

1. Protect adjacent facilities from damage due to demolition activities.
2. Protect existing site improvements, appurtenances, and landscaping to remain.
3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION

A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
2. Maintain fire watch during and for at least 24 hours after flame-cutting operations.
3. Maintain adequate ventilation when using cutting torches.
4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.

C. Explosives: Use of explosives is not permitted.

D. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

E. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

F. Salvage: Items to be removed and salvaged are indicated above.

G. Demolish foundation walls and other below-grade construction in it’s entirety.

H. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures that are within shown on the plans within the area of [new construction..

I. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with **satisfactory soil materials** according to backfill requirements in Section 312000 "Earth Moving."

J. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

K. Promptly repair damage to adjacent buildings caused by demolition operations.

3.6 CLEANING

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction, and recycle or dispose of them according to Section 01 74 19 "Construction Waste Management and Disposal."

B. Do not burn demolished materials.

C. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION 02 41 16

SECTION 02 60 00 - EXCAVATION AND DISPOSAL OF CONTAMINATED SOIL AND GROUNDWATER

PART 1 – GENERAL

1.1 GENERAL

A. Construction activities under this contract may require working with potentially contaminated material including soils and liquids, and potentially working in low oxygen or combustible atmospheres due to the presence of petroleum hydrocarbons. In addition to potential site hazards, the migration of contaminants off site must be controlled.

B. This Section includes work necessary for excavation, removal, and disposal of contaminated soil and groundwater as specified herein and in accordance with Maryland Department of the Environment (MDE) regulations and requirements.

C. The work also includes, but is not limited to, furnishing notification and obtaining permits required by federal, state, and local regulating agencies, and furnishing all certifications and other official documentation required by federal, state, and local regulating agencies concerning the disposal of contaminated and/or non-hazardous wastes.

1.2 REFERENCES

A. American Petroleum Institute (API)

1. API PUBL 1628 A Guide to the Assessment and Remediation of Underground Petroleum Releases (1996).

2. API RP 2003 Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents (1998).

B. Code of Maryland Regulations (COMAR)

1. COMAR 26.10.08 Spill, Release, and Discharge Reporting, Investigation, and Confirmation.

2. COMAR 26.10.09 Spill, Release, and Discharge Response and Corrective Action.

3. COMAR 26.10.13 Oil-Contaminated Soil.

C. U.S. Environmental Protection Agency (EPA)

1. EPA SW-846 Test Methods for Evaluating Solid Waste.

2. EPA 40 Code of Federal Regulations (CFR) Part 260 Hazardous Waste Management System: General.

D. Occupational Safety and Health Administration (OSHA)

1. OSHA 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response.

E. National Fire Protection Association (NFPA)

1. NFPA 70 National Electrical Code.

1.3 PROJECT CONDITIONS

A. Contaminated soil and/or contaminated groundwater might be found at the project site. The Contractor shall inform the Engineer immediately when petroleum hydrocarbon contamination is encountered in groundwater or excavated soil, and the Engineer shall notify MDE.

B. The Contractor shall locate, analyze, remove, dispose of, document, and provide all incidental services associated with the contaminated soil and groundwater if encountered within the limits of disturbance and as described in this Section.

C. If the Contractor encounters or exposes any abnormal conditions during excavation that indicate the presence of a hazardous or toxic material other than those covered in this Section, work in that area shall immediately be suspended and the Engineer shall be notified. The Contractor's operations in this area shall not resume until permitted by the Engineer; however, the Contractor may continue working in other areas of the project, unless directed otherwise.

1. Abnormal conditions shall include, but not be limited to, the presence of suspected asbestos materials, noxious or unusual odors, excessively hot earth, smoke, and other conditions that could indicate the presence of hazardous material or toxic waste.

2. Disposition of the hazardous or toxic material shall be made in conformance with all applicable requirements and regulations.

3. The site-specific Health and Safety Plan (HASP) required per Section 01 33 00 shall discuss the site procedures that shall be enacted should these abnormal conditions be encountered (i.e., work stoppage, re-evaluation of site hazards, modification to the HASP, potential for upgrade in personal protective equipment, additional worker training, etc.).

1.4 TESTING AND CERTIFICATION

A. The Contractor shall perform all testing and furnish all equipment, instruments, qualified personnel, and facilities necessary to perform all tests required by the Contract. If necessary, the Contractor shall supply an independent testing laboratory to provide testing services. The testing laboratory shall be approved by the Engineer.

B. The Contractor shall give sufficient notice to the Engineer to permit them to witness the tests.

C. The Contractor shall submit the name, address, and qualifications together with the scope of proposed services of the proposed testing laboratory to the Engineer for approval at least thirty (30) days prior to the scheduled commencement of any work. Should the Contractor desire to use more than one laboratory for testing, the required information shall be submitted for each proposed laboratory as specified herein.

D. The Contractor shall be responsible for furnishing all equipment and tools necessary to prepare and preserve the test samples as prescribed, and delivering them to the approved testing laboratory.

E. All tests performed, and test results for each day shall be recorded in a daily report. These records shall remain complete and available to the Engineer at all times during the performance of work under the Contract. Test records shall indicate the reference test, nature, and number of observations made, and the number and type of deficiencies found.

PART 2 – PRODUCTS

2.1 GENERAL

A. The Contractor shall be responsible for providing to their employees and subcontractors, any personal protective equipment, monitoring equipment, or materials required to implement engineering controls required for worker protection.

PART 3 – EXECUTION

3.1 GENERAL

A. Safety Guidelines: Personnel working within the general vicinity of the project shall be trained and thoroughly familiar with the safety precautions, procedures, and equipment required for controlling the potential hazards associated with this work. Personnel shall use proper protection and safety equipment during work hours. The Contractor shall observe appropriate safety precautions such as installing vapor isolating barriers, vapor concentration monitoring, and using equipment listed for use in hazardous zones as mitigation. Safety guidelines shall be documented in the site-specific HASP required for Specification 01 33 00.

B. Burning and Explosives: Use of explosives or burning will not be allowed.

C. Contaminated soils and groundwater shall be hauled and disposed of by the Contractor in accordance with all federal, state, and local requirements.

D. Contaminated soils and groundwater must be handled in a manner that would comply with state and local regulations regarding sediment control and disposal.

E. Contractor shall furnish a properly calibrated combustible gas indicator (CGI) available to monitor for volatile vapor concentrations in the work area at all times. Calibration of the CGI shall be in accordance with the manufacturer’s instructions. Operators of the CGI shall be completely familiar with the use of the instrument and the interpretation of the instrument readings and shall be approved by the Engineer before any work will be allowed to commence.

F. If evidence of petroleum hydrocarbon is observed, scan the area for the presence of vapors and render the area non-combustible as necessary for safe performance of the work.

G. All potentially contaminated materials shall be analyzed by the Contractor for disposal purposes per applicable regulations and disposal facility requirements.

H. Records: Records shall be maintained of all waste determinations, including transportation manifests disposal receipts, and other data required by MDE and other regulatory agencies. Following Contract closeout, the records shall become the property of Baltimore County Property Management (BCPM).

I. Spills: Immediate containment actions shall be taken, as necessary, to minimize the effect of any spill or leak. Cleanup shall be in accordance with applicable federal, state, and local laws and regulations at no additional cost to BCPM. The Contractor shall report spills related to project activities to MDE and the Engineer immediately following discovery, and shall also comply with all applicable federal, state, and local requirements for spill response. A written follow-up report shall be submitted to the Engineer no later than seven (7) days after the removal.

3.2 CONTAMINATED SOIL

A. As discussed previously, contaminated soils may be encountered in the project area. Excavation, placement, stockpiling, reuse and/or disposal shall be handled as described herein.

1. Excavation: When excavation is performed in the area where contaminated soils have been identified by the Contractor, the material will not be reused and shall be removed from the project area to a pre-determined location. The removed materials will be handled in the following manner:

a. The Contractor shall provide written notification to the Engineer in advance (minimum of seventy-two (72) hours' notice) of when excavation of petroleum-impacted soils is expected to occur so that the Engineer can provide any required notice to MDE.

b. Excavation shall be performed in a manner that will limit the amount of potentially petroleum-contaminated soil that could be mixed with previously uncontaminated soil. Contaminated soil shall be reported in writing immediately to the Engineer. Surface water shall be diverted to prevent direct entry into the excavation.

c. The Contractor shall visually monitor all excavated soils for staining and ambient air for petroleum odor in work zones during all earthwork operations. If evidence of staining or petroleum odor exists, the Contractor shall notify the Engineer immediately. If free product is observed, Contractor shall immediately notify the Engineer who shall immediately notify MDE. Material suspected of contamination shall be segregated and stockpiled separately from non-contaminated material for possible subsequent handling as a non-hazardous substance.

d. Excavated material which is visibly stained and which has an obvious petroleum odor, shall be considered contaminated and shall be reported immediately to the Engineer before proceeding. Contaminated soil shall be temporarily stockpiled separately on plastic sheeting, covered, and bermed to prevent contaminated soils from contacting clean soils or entering adjacent storm drains, inlets, and other waters. Place excavated material at sufficient distance from the limits of excavation so as not to cause cave-ins or bank slides, but in no case closer than 3 feet from the edge of excavations.

e. Petroleum-impacted soils shall be stockpiled in a pre-approved and pre-determined location and in accordance with COMAR. The procedures should include measures to prevent the spread of contamination during rain and non-rain events and to protect the public (i.e., secure location, pile cover, sorbents, hay bales, etc.).

Field screening instruments should be used to monitor for the presence of petroleum impacted soil in all excavation areas to assist with soil segregation and to document field conditions.

Contractor shall document the environmental disposition of all excavated soil and shall confer with the Engineer, and/or MDE personnel as necessary to ensure proper handling, manifesting, and disposal. Concurrence should be reached between the Contractor and the Engineer prior to excavation as to who bears signature authority for waste manifestation of the non-hazardous waste streams. Soils must be disposed of by the Contractor at approved facilities commensurate with the degree of impact and the media they contain.

f. If the excavation is found to contain grossly contaminated groundwater and/or floating product, upon request of and as directed by the Engineer, arrangements shall be made by the Contractor for their removal. If free product is observed, Contractor shall immediately notify the Engineer who shall immediately notify MDE.

2. Storage: Contractor must create a disposal location at the job site where soil can be staged until soil material is transported off site for disposal. All non-hazardous soil shall be placed on, and completely covered by, strong plastic sheeting (or equivalent) and in accordance with COMAR 26.10 for petroleum-impacted soil stockpiling provisions. For petroleum-impacted soils, excavated soils shall be removed from the site within thirty (30) days in accordance with COMAR 26.10.

3. Disposal: The Contractor will be responsible for disposition of contaminated soils as outlined below:

a. Disposal of contaminated soil shall be in accordance with MDE regulations. Disposal work shall include all necessary personnel, labor, transportation, packaging, detailed analysis (if required for disposal, manifesting or completing waste profile sheets), equipment, permitting, and reports.

b. Obtain waste disposal characterization samples from each soil waste stream in accordance with requirements of the selected disposal facility. The number of samples and sample analyses required will be based on the permit requirements of the selected disposal facility. Site assessment soil results are provided in the Project Manual as information only. The Contractor is required to perform their own characterization of contaminated soils.

c. The hauler shall transport the contaminated soil to a treatment or disposal facility licensed by state and federal regulatory authorities for acceptance of such wastes. All waste material shall be transported and disposed of in accordance with all applicable regulations.

d. The Contractor shall haul petroleum-contaminated soils from the site directly to an accepting soil treatment facility. Unnecessary stops en route or parking of the vehicle will not be permitted. Transportation of petroleum-contaminated and/or hazardous soils shall be in accordance with all applicable Maryland Department of Transportation (DOT) regulations, other state DOT agency regulations as necessary when transporting these materials across state lines, and Federal DOT regulations. The soil treatment facility shall be fully permitted in the treatment of petroleum-contaminated and/or hazardous soils and shall have a current license to operate in the state where located. Petroleum-contaminated and/or hazardous water and sludge shall be transported and disposed of per all federal, state, and local requirements.

e. The Contractor shall provide all necessary waste characterization analysis results, manifests, and certificates of contaminant disposal and disposal volumes to the Engineer for their records.

3.3 CONTAMINATED GROUNDWATER

A. As discussed previously, contaminated groundwater may be encountered in the project area. Identifying, transporting, and treating contaminated groundwater shall be handled as described herein and in accordance with any applicable local, state, or federal regulations.

1. Dewatering. The Contractor shall develop an overall dewatering plan with design details as part of the shop drawing phase of the Contract to minimize contaminated groundwater flow into trenches and structural excavations. These plans and details shall include, but are not limited to, design of sheeting and shoring, concrete tremie seal or clay foundation seals, and pervious foundation depths with maximum pumping rates for various groundwater inflow rates. The Contractor shall state if continuous excavation, pipe laying, and backfill operations will be employed and the maximum length of open trench that will be used.

2. The Contractor shall pump water from open excavations only, shall plug pipes, and shall divert other sources of water so that no liquid other than groundwater and precipitation collects in the project area.

3. Groundwater Management. The Contractor shall manage groundwater pumped due to dewatering, in the project area. The Contractor may set up and maintain a groundwater treatment system designed to treat water for the presence of suspended solids, free product, and/or dissolved hydrocarbons. The Contractor may also elect to containerize the water for subsequent treatment and/or discharge or off-site disposal. Either groundwater management option shall have sufficient capacity to manage groundwater inflow into the open excavation. To the maximum extent practicable, the Contractor shall prevent the mixing of contaminated groundwater with uncontaminated groundwater to minimize the water volume requiring treatment or disposal. Any fluids removed from the site for off-site disposal must be transported to a licensed facility permitted for acceptance of the specific waste material. Sampling and laboratory analysis may be required to meet the requirements of the disposal facility or to determine appropriate permit requirements.

4. It is the responsibility of the Contractor to obtain any and all necessary permits that pertain to discharge or otherwise. For information, contact the MDE Waste Management Administration at 410-631-3443.

5. It is the responsibility of the Contractor to report, contain, and clean up any spills occurring as a result of dewatering activities until the water is treated in compliance with the discharge permit.

END OF SECTION 02 60 00

SECTION 02 65 00 - REMOVAL OF EXISTING UNDERGROUND TANK

PART 1 – GENERAL

1.1 DESCRIPTION

A. Contractor will be responsible for the removal of the following tank systems:

1. Tank 1 – 4,000 gallon gasoline underground storage tank (UST), refer to Phase I ESA in Appendix

B. Contractor shall completely remove and dispose of one (1) existing UST and piping and appurtenances as required by the scope of work for this project. Removal work shall include the demolition and removal of the underground tank, concrete and asphalt paving, overburden soil, tank bedding, riser pipes, monitoring pipes, product and vent piping, wiring/conduits, fuel pump, fuel dispenser and containment sumps, associated petroleum products, and all other incidentals to complete the work as required. Tank anchoring (such as concrete hold-down pads, concrete deadman, etc.) to be removed only if required by Maryland Department of Environment (MDE). If encountered, the Contractor shall remove potentially petroleum-impacted soils as designated by the state and as specified in Section 02 60 00. Contractor shall remove and dispose of all other associated demolition scrap as debris.

C. Contractor must submit proposed shoring and/or other protection methods for review and approval by Engineer.

D. Contractor shall coordinate the removal of usable fuel with Baltimore County Property Management (BCPM). Contractor shall remove remaining tank contents including residues, sludges, and any other solids or liquids whether flammable or not, and whether existing or generated by Contractor's cleaning activities. Contractor shall provide all labor, material, equipment, and services to empty, clean, and transport all remaining tank contents in accordance with federal, state, and local regulations, and in such a manner that contents are not discharged to the local environment. Contractor shall perform pump-out, recovery, removal, legal disposal, and cleanup of all fuel residues remaining in the existing tank and distribution piping.

E. All fuel, contaminated soil, and off-site waste disposal facilities shall be approved by BCPM. Locations of all off-site disposal facilities shall be submitted to the Engineer for approval ten (10) days prior to removal.

1.2 CONFORMANCE WITH REGULATIONS, CODES, STANDARDS, AND SPECIFICATIONS

A. All work in this Section, including materials, equipment, and installation work, shall be in strict conformance with all applicable regulations, manufacturers' recommendations, codes, and standards.

1. U.S. Environmental Protection Agency (EPA) Final Rule; Federal Regulations: Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks. Title 40, Code of Federal Regulations, Part 280 (40 CFR Part 280).

2. State of Maryland, Department of the Environment, Title 26, Subtitle 10, Oil Pollution Control and Storage Tank Management (Code of Maryland Regulations [COMAR] 26.10).

3. National Fire Prevention Association (NFPA) Standards:

   a. NFPA 30: Flammable and Combustible Liquids Code.
   b. NFPA 30A: Motor Fuel Dispensing Facilities and Repair Garage.

4. American Petroleum Institute (API) Recommended Practice (RP) For the Closure of Underground Petroleum Storage Tanks (API RP 1604).

1.3 OWNERSHIP AND TITLE

A. Prior to the start of any demolition, the Contractor shall perform a detailed inspection with a Baltimore County representative and prepare an itemized list of equipment to be salvaged by the County. The Contractor shall be responsible for the removal, transportation, and unloading of all salvaged equipment to the County preferred storage location. All other equipment shall be disposed of by the Contractor at no additional cost to BCPM.

B. When waste materials are removed from the project site, ownership and title thereof shall pass from the state to the Contractor, who shall at that time assume all incidents of ownership of said waste materials and bear all liability and responsibility for their safe and lawful transportation, storage, and disposal.

C. The Contractor is encouraged to salvage items and materials to the maximum extent possible and in accordance with all federal, state, and local laws, regulations or ordinances, and as detailed on the Contract drawings.

D. Materials salvaged by the Contractor shall be stored as approved by the Engineer and shall be removed from the project site before completion of the project.

1.4 NOTIFICATION REQUIREMENTS

A. The Contractor shall notify MDE Oil Control Program in writing thirty (30) days prior to the beginning of excavation for UST removal. Notification shall be provided by completing and submitting the "*Underground Storage System Removal/Abandonment 30-Day Written Notification Form.*" It is recommended that the completed form be emailed to MDE and that a record of the email transmission be retained to provide proof of notification.

The Contractor shall confirm the tank removal with MDE forty-eight (48) hours before beginning excavation. The notification shall be provided to the following:

Maryland Department of the Environment
Oil Control Program
1800 Washington Boulevard
Baltimore, Maryland. 21230
Attention: (*Appropriate Regional Compliance Inspector)*
Telephone: (410) 537-3442
Fax: (410) 537-3092

B. The Contractor shall call "MISS UTILITY" at 1-800-257-7777 to obtain utility information at least seventy-two (72) hours prior to excavation. The Contractor is responsible for identifying all underground and aboveground utilities that may be impacted by the UST removal. The Contractor shall provide advance notification to BCPM of any additional utility location personnel that will be on site.

C. Contractor shall verbally notify the regulating state agency (MDE) at least five (5) days prior to closure of the tank. Written documentation of the notification must be provided to the Engineer.

D. If required, the Contractor shall notify the local authority having jurisdiction, typically the local Fire Marshal, of the impending tank removal. Written documentation of the notification must be provided to the Engineer.

E. If, during the tank removal, evidence of a past or ongoing fuel release is discovered, the Contractor shall provide written notification to the Engineer immediately. Additionally, MDE must be notified of a fuel release within two (2) hours by calling 866-633-4686.

F. Where written notifications are to be provided, the Contractor shall submit documents to the Owner and the Engineer for review and approval prior to submittal.

1.5 REFERENCES

A. API

1. API 2015 Safe Entry and Cleaning of Petroleum Storage Tanks (2014).

2. API PUBL 1628 A Guide to the Assessment and Remediation of Underground Petroleum Releases (1996).

3. API RP 2219 Safe Operation of Vacuum Trucks in Petroleum Service (2005).

4. API RP 1604 Closure of Underground Petroleum Storage Tanks (2021).

5. API RP 2003 Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents (1998).

6. API Standard (STD) 2217A Guidelines for Safe Work in Inert Confined Spaces in the Petroleum and Petrochemical Industries (2005).

B. COMAR

1. COMAR 26.10.02 Underground Storage Tank Systems.

2. COMAR 26.10.06 UST System Technician, Remover, and Inspector Certification.

3. COMAR 26.10.08 Spill, Release, and Discharge Reporting, Investigation, and Confirmation.

4. COMAR 26.10.09 Spill, Release, and Discharge Response and Corrective Action.

5. COMAR 26.10.10 Out-of-Service UST Systems and Closure.

6. COMAR 26.10.13 Oil-Contaminated Soil.

C. EPA

1. EPA SW-846 Test Methods for Evaluating Solid Waste.
2. EPA 40 CFR Part 260 Hazardous Waste Management System: General.
3. EPA 40 CFR Parts 280 and 281 Underground Storage Tanks.

D. Occupational Safety and Health Administration (OSHA)

1. OSHA 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response.

2. OSHA 29 CFR 1910.146 Permit-Required Confined Spaces.

3. OSHA 29 CFR 1910.147 The Control of Hazardous Energy (Lockout/ Tagout).

1.6 SUBMITTALS

A. Submit to the Engineer a Tank Removal Plan. Plan must be approved by the Engineer prior to start of any removal work. However, approval of this plan is for general compliance only, and does not relieve the Contractor from full compliance with the Contract Documents, and all applicable codes, regulations, and standards. The plan shall include the following minimum requirements:

1. Identification of site constraints and job hazards;

2. Environmental Safety and Health procedures for the work;

3. Identification of any possible ignition sources;

4. Determination of potential for contaminated backfill, soil, or liquids;

5. Determination of need to de-water excavation;

6. Identification of staging area for stockpiling backfill materials;

7. Identification of area for storing tank;

8. Earth retention requirements and methods;

9. Pipe purging, removal, and capping procedures;

10. Tank purging/inerting methods; and

11. Erosion and Sediment (E&S) measures.

B. Submit to the Engineer a Spill Prevention and Control Plan. Plan must be approved by the Engineer prior to start of any removal work. However, approval of this plan is for general compliance only, and does not relieve the Contractor from full compliance with the Contract Documents, and all applicable codes, regulations, and standards. The Contractor shall have a Spill Prevention and Control Plan in place in the event that a spill is encountered during construction. The Contractor shall ensure that all personnel participating in construction activities are aware of this plan and are prepared to execute the spill control plan if necessary. The Contractor shall provide the equipment necessary to execute the spill control plan in the event that a spill is encountered.

C. Submit UST remover certification to the Engineer in accordance with COMAR 26.10.06.

D. Submit to the Engineer a copy of the MDE Underground Storage Tank Removal/ Abandonment Notification Form, as well as copies of notifications submitted to all local government agencies as required.

E. Submit copies of the MDE inspector's "Tank Removal/Abandonment Form" and "Report of Observations" to the Engineer.

F. Submit copies of all Hazardous and Non-hazardous Waste Manifests to the Engineer.

G. Submit to the Engineer a written confirmation from each of the disposal or recycling facilities indicating acceptance of the UST, UST contents, concrete and asphalt paving materials, piping, and any product, sludge, or contaminated wash water.

H. Submit to the Engineer a copy of the chain-of-custody form(s) and all laboratory certificates of analysis for all soil and/or water samples collected and submitted for laboratory analysis.

I. Submit to the Engineer any additional permits, waste slips, manifests, and Bills of Lading at project closeout.

J. Submit to the Engineer a UST System Closure Report in accordance with COMAR 26.10.10.03 Assessing the Site at Closure or Change-in-Service.

1.7 QUALITY ASSURANCE

A. All work shall be performed in accordance with all applicable federal, state, and local codes, regulations, and standards governing the closure of USTs. The Contractor shall demonstrate to the satisfaction of the Engineer that the qualification requirements of the State of Maryland are met prior to award of the Contract. Specifically, the Contractor shall meet all of the requirements of COMAR 26.10.06. A copy of certification, specified in COMAR 26.10.06, shall be submitted in accordance with the Submittal specifications.

B. In accordance with COMAR 26.10.06, the Contractor shall have a minimum of five (5) years of UST closure and/or removal experience with direct involvement in at least six (6) systems.

1.8 MATERIALS ENCOUNTERED

A. If the Contractor encounters or exposes any abnormal conditions during UST closure that indicate the presence of a hazardous or toxic material other than those covered in this Section, work in that area shall immediately be suspended and the Administration and Engineer shall be notified. The Contractor's operations in this area shall not resume until permitted by the Engineer; however, the Contractor may continue working in other areas of the Project, unless directed otherwise.

1. Abnormal conditions shall include, but not be limited to, noxious or unusual odors, excessively hot earth, suspected asbestos materials, smoke, and other conditions that could indicate the presence of hazardous material or toxic waste.

2. Baltimore County shall be listed as the generator of the hazardous or toxic material and disposition of the hazardous or toxic material shall be made in conformance with all applicable requirements and regulations. Where the Contractor performs necessary work, as directed by the Engineer, and must dispose of these materials with no Bid Items covering this work included in the Bid Form, the work shall be performed in accordance with the General Provisions.

3. The Engineer may require any material furnished on the project by the Contractor suspected to be hazardous or toxic, to be tested and certified to be in conformance with all applicable requirements and regulations.

4. Material found to be hazardous or toxic shall not be incorporated into the work. The required testing will be determined by the Engineer and may include, but not be limited to, the EPA Toxicity Characteristic Leaching Procedure or its successor. The evaluation and interpretation of the test data will be made by the Engineer.

1.9 SAFETY AND PRECAUTION

A. All safety and precaution measures shall be included in site-specific Health and Safety Plan required in Section 01 33 00.

B. The Contractor shall determine the appropriate level of personal protection for all workers associated with work performed under this Section to ensure health and safety of all personnel, including subcontractors, engaged in the tank removal activities.

C. The Contractor shall provide personal protective equipment (protective suits, gloves, boots, hard hats, respiratory equipment etc.) for all workers as required for protection against exposure to contamination. Contractor shall determine the required level of personal protective equipment during each phase of the work. Contractor shall ensure their personnel are properly trained to use these items. Contractor shall follow all OSHA requirements.

D. Personnel working inside and in the general vicinity of the UST shall be trained and thoroughly familiar with the safety precautions, procedures, and equipment required for controlling the potential hazards associated with this work. Personnel shall use proper protection and safety equipment during work in and around the UST.

E. The area surrounding the tank and/or tank excavation shall be secured by temporary fence to protect building occupants, visitors, and workers. A temporary fence will only be necessary if the Contractor cannot control access by other means. Alternate methods for access control must be approved in writing by the Engineer.

F. Warning signs and devices in number and content satisfactory to the Engineer shall be in place at regular intervals along the work area perimeter.

G. The Contractor shall eliminate all potential sources of ignition from the area, including but not limited to, smoking materials, non-explosion-proof tools, electrical equipment, and internal combustion equipment.

H. The Contractor shall provide and maintain adequate supply of fire extinguishers and other required safety equipment in close proximity to all demolition and removal activity. A minimum of two (2) portable twenty (20) pound fire extinguishers must be visibly positioned around the tank excavation. The fire extinguishers must be in working condition, fully charged, and immediately available in the event of a fire.

I. The Contractor shall prevent vapors from accumulating at ground level and keep the tank vented at least twelve (12) feet above ground surface until ready to be removed. The Contractor shall prevent a discharge of static electricity during venting of tanks by ensuring that all equipment used during venting is grounded to both the tank and the earth.

J. The Contractor shall prepare confined space entry permits for all activities where personnel enter confined spaces. If confined spaces must be entered, all OSHA and Maryland Occupational Safety and Health (MOSH) procedures for confined space entry shall be followed, including 29 CFR 1910.146 and COMAR 09.12.35.

K. The Contractor shall test the interior UST space and surrounding excavation areas to detect dangerous vapor levels until the USTs are removed from the project site.

L. Prior to ending operations on any workday, or at any time the Contractor is not on the site, the Contractor shall secure all areas of work in a safe manner to the satisfaction of the Engineer.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 GENERAL

A. Remove tank only in the presence of and/or at the direction of an MDE representative.

B. All work shall be performed in strict accordance with the provisions of the Contract Documents and with the provisions of API RP 1604. If there is any discrepancy, the more stringent provisions shall govern.

C. Safety Guidelines: Personnel working inside or within the general vicinity of the tanks shall be trained and thoroughly familiar with the safety precautions, procedures, and equipment required for controlling the potential hazards associated with this work. Personnel shall be trained and certified in accordance with OSHA 29 CFR 1910.120 and OSHA 29 CFR 1910.146 (permit-required confined spaces) and physically carry proof of certification at all times on the site. Personnel shall use proper protection and safety equipment during work in and around the tanks as specified in API STD 2217A, API RP 1604, and the Contract Documents.

D. Burning and Explosives: Use of explosives or burning will not be allowed.

E. All supply pipes, vents, fill pipes, and other appurtenances related to the fuel distribution system shall be removed or cut and capped at both ends prior to removal by the Contractor no later than forty-eight (48) hours after proper cleaning was completed, and after Engineer has provided authorization to do so upon demonstration that the system is vapor free. No piping shall be abandoned in place without the permission of MDE.

F. The Contractor shall coordinate their work to allow vehicular and pedestrian ingress and egress during construction.

G. During the closure, the Contractor shall maintain vehicular and pedestrian traffic flow safely through the parking lot.

H. All health and safety monitoring equipment shall be maintained according to manufacturer’s specifications.

3.2 SITE PREPARATION

A. The existing tank location and piping as shown on the Contract drawings are approximate. The Contractor shall be responsible for verification of the exact location of the underground tank and piping.

B. Familiarize all personnel with the general work area. Locate and mark buried obstructions and other buried utility lines in the area. Use a pipe locator if necessary. The Contractor is

responsible for protecting all buried and overhead utilities to remain. Any damage done to existing utilities by the Contractor shall be repaired by the Contractor at no cost to the Administration.

C. Notify the Engineer at least forty-eight (48) hours prior to the commencement of work.

D. Place barriers and warning signs as approved by the Engineer to prevent unauthorized entry into work area and to protect all excavation areas.

E. Prohibit or mitigate all potential ignition sources within twenty-five (25) feet of the work area or other zone as defined by NFPA 70. Potential ignition sources include open flames, spark-producing equipment, and high-temperature equipment such as internal combustion engines. Contractor shall observe appropriate safety precautions such as installing vapor isolating barriers, vapor concentration monitoring, and using equipment listed for use in hazardous zones as mitigation. Contractor shall include safety measures in Site-Specific Health and Safety Plan submitted for approval in accordance with Section 01 33 00.

F. Coordinate removal of usable fuel from the tank with BCPM prior to work related to removal of the UST. All flammable or combustible liquids and/or sludge remaining in the tank and/or piping after usable fuel has been removed shall be removed and disposed of by the Contractor.

G. Turn off, secure, and label pump circuit breakers, and disconnect wiring to the pumps at the panel in accordance with OSHA 29 CFR 1910.147.

H. Prevent the discharge of static electricity by properly grounding equipment and by controlling the rate of flow of gases and liquids during the work.

I. Prevent the accumulation of vapors at ground level by proper venting.

J. Furnish a properly calibrated combustible gas indicator (CGI) to monitor for hazardous vapor concentrations in the work area at all times. Calibration of the CGI shall be in accordance with the manufacturer’s instructions. Operators of the CGI shall be completely familiar with the use of the instrument and the interpretation of the instrument readings. The CGI shall be approved by the Engineer before any work will be allowed to commence.

K. Scan the area for the presence of vapors and render the area non-combustible as necessary for safe performance of the work.

3.3 TEST PIT EXCAVATION

A. Test pit excavation may be required for location of existing utilities. It shall be the responsibility of the Contractor to determine the location of underground structures and utilities by the use of test pit excavation prior to excavation operations. Each pit shall be backfilled and compacted as specified in Section 31 20 00. Provide geotextile prior to aggregate backfill to separate excavated grade. Geotextile shall be MDSHA PE type I nonwoven or approved equal. Geotextile shall be sewn unless overlap can be demonstrated and approved by the Engineer.

3.4 PROTECTION OF ADJACENT PAVEMENTS

A. Existing roadway and parking lot pavements shall be protected to the greatest extent possible from damage during excavation and subsequent construction activities.

B. Damage to adjacent pavement outside the sawcut area indicated on the plans shall be repaired and restored to original condition at no additional cost to BCPM.

3.5 SITE DEMOLITION

A. Prior to start of demolition operations, the Contractor shall install E&S control measures and devices in accordance with the Contract drawings to protect adjacent undisturbed areas and prevent runoff from entering the site stormwater system.

B. All materials coming into contact with the tank, or in the vicinity of the excavation, such as shovels, slings, and tools, shall be of the non-sparking type.

C. All saw cutting shall be performed as specified in Contract Documents.

D. Excavated material that is visibly stained and that has an obvious petroleum odor shall be considered contaminated and shall be reported immediately to the Engineer before proceeding. Contaminated soil shall be managed in accordance with Specification Section 02 60 00.

E. Contractor shall exercise care to preserve the material below and beyond the limits of excavation. Where excavation is carried below grade, backfill to the required grade.

3.6 TANK PREPARATION

A. Locate and identify tank. The Contractor is responsible for determining exact location of underground work.

B. The Contractor shall make all practicable attempts to plan the tank removal in such a manner that reduces or eliminates the need for personnel to enter the interior of the tank and tank excavation.

C. The Contractor shall disconnect all electrical service going to, under, or through the tank, tank appurtenances, and excavation area. All electrical service must be disconnected at the circuit breaker prior to the initiation of any tank removal activities. Proper lockout/tagout procedures must be followed. The Contractor shall ensure that any electrical power connected to the tank or its ancillary equipment such as pumps/dispensers has been deactivated prior to beginning work each day.

D. All piping conduits and wiring shall be disconnected prior to excavation.

E. Contractor shall be fully responsible for sampling, testing, and quantifying existing contents of all tanks prior to excavation, to determine safe and lawful methods of handling, transport, and disposal.

F. The Contractor shall be responsible for the storage, transfer, and/or disposal of any petroleum products, liquids, sludges, or solids remaining within tanks after removal of usable fuel as directed by the Engineer.

G. The Contractor shall document that the disposal facilities proposed have all certifications and permits required by state and federal regulatory agencies to receive and dispose of the liquid and solid wastes resulting from performance of the work.

H. Remove residues and liquids from the tanks using explosion-proof or air-driven pumps certified by the manufacturer to be compatible with pumped media. All pump motors shall be properly grounded and suction hoses shall be bonded to the tanks, or otherwise

grounded, to prevent electrostatic ignition hazards. If necessary, use a hand pump to remove the last few inches of liquid from the bottom of the tank.

I. Carefully excavate to the top of the tank to expose all pipe fittings or other appurtenances attached to the tank. Excavated material shall be monitored visually and with the CGI for indications of contamination. Material suspected of contamination shall be segregated and stockpiled separately from non-contaminated material for possible subsequent handling as a hazardous substance.

J. Remove the fill pipe, gauge pipe, vapor recovery truck connection, pump, and other tank appurtenances. Leave the vent line connected until the tanks are purged completely.

K. Cap all non-product lines, such as vapor recovery lines. Temporarily plug all other tank openings so that all vapors will exit through the vent line during the inerting process.

L. Utilize heavy equipment to demolish and remove fill material around the UST system. Material shall be field screened with a photoionization detector (PID) and segregated for off-site disposal.

3.7 EXCAVATION, ACCESS, AND REMOVAL OF UNDERGROUND STORAGE TANKS

A. The Contractor's Certified UST Technician or Remover must be on site during all aspects of UST removal.

B. Remove tanks only in the presence and/or at the direction of an MDE representative.

C. All UST removals shall be conducted in accordance with the latest edition of API RP 1604.

D. Whenever possible, do not enter the tank. Perform all work from outside the tank using whatever special equipment is required for disconnecting, cleaning, purging, combustible gas monitoring, etc. If the tank must be entered, all OSHA and MOSH procedures for confined space entry shall be followed, including 29 CFR 1910.146 and COMAR 09.12.35.

E. Whenever possible, do not enter the tank excavation. Perform all work from outside the tank excavation using whatever special equipment is required for disconnecting, cleaning, purging, combustible gas monitoring, etc. If the tank excavation must be entered, all personnel working in an excavation shall be protected from cave-ins in accordance with 29 CFR 1926.650-652, and applicable MOSH amendments to the OSHA Standard.

F. Perform frequent combustible gas meter readings of the tank interior atmosphere during preparation, cleaning, storage, and cutting. Monitor the atmosphere as required to ensure that there is never the potential for fire or explosion. Prevent vapors from accumulating at ground level. Keep tank properly vented until ready to remove from the excavation.

G. All flammable and/or combustible liquids shall be removed from the UST system. During the transfer of any combustible and/or flammable liquids, follow electrical grounding procedures set forth by NFPA to prevent fire or explosion due to static electricity.

H. The Contractor shall drain all product piping back into the tank. The Contractor may use small amounts of water or nitrogen to flush the piping. If water is used, the Contractor shall use no more than one (1) gallon of water for every ten (10) feet of one and a half (1.5)-inch-diameter pipe, or two (2) gallons of water for every ten (10) feet of two (2)-inch-diameter pipe.

I. All flammable or combustible liquids, petroleum-impacted-liquids, and/or sludge removed from the system by the Contractor shall be disposed of by the Contractor in accordance with all applicable federal, state, and local codes and regulations.

J. The Contractor shall avoid spilling any petroleum products during the tank removal process. The Contractor is responsible for the cleanup and remediation of any and all releases of oil to the environment that occur during the tank removal process.

K. Remove asphalt and/or concrete above tank only to the extent needed to expose the tank or perform subsequent removal of petroleum-impacted soils. In either case, the limits of excavation shall be approved by the Engineer. Care shall be taken to protect the existing pavement and concrete adjacent to the excavation.

L. Excavate to the top of the tank. Remove all tank-top equipment including riser pipes, fill pipes, drop tubes, supply pipes, vapor recovery pipes, automatic tank gauging equipment, vapor recovery piping and equipment, submersible pump turbine and pump head, wiring and electrical conduits, and all other associated underground piping and appurtenances related to the fuel distribution system. Remove all piping and conduit that is accessible and uncovered, except the vent line. Any remaining piping must either be cut and capped or completely filled with concrete or cement. No piping shall be abandoned in place without the permission of MDE.

M. Handle and treat petroleum-contaminated items properly to prevent spread of contamination or release of product. Clean petroleum contamination from items as required before disposal.

N. The vent line must remain connected until the tank is purged. Cap and plug all bungs on tank as tank-top equipment and risers are removed.

O. Prior to removal of the tank, the Contractor shall either purge the tank of all explosive vapors or inert the tank by removing or displacing the oxygen within the tank. Purge or inert the tank in place with either method below using safeguards and procedures described in API RP 1604.

1. Carbon dioxide (CO_2) or nitrogen (N_2) flooding.

2. Solid CO_2 at one and a half (1.5) pounds per one hundred (100) gallons of tank capacity.

3. Ventilate tank with a compressed air eductor or diffused air blower.

DO NOT USE OXYGEN OR COMBUSTIBLE
FLAMMABLE, OR EXPLOSIVE GAS TO PURGE TANK

After purging the tank, test tank and tank excavation with a CGI to verify vapor concentrations of ten (10) percent of lower explosive limit (or less). Purge until tank interior atmosphere remains continuously at this level or below, even when purging is discontinued. If a CGI is used, always test the environment for oxygen content first to be sure the instrument can be relied upon. CGIs may be misleading if the tank atmosphere contains less than fifteen (15) percent by volume oxygen.

If the tank was inerted, use an oxygen indicator to determine if the oxygen concentration within the tank is at or below fifteen (15) percent. The tank shall be inerted until the interior atmosphere remains continuously at this level or below, even when inerting is discontinued.

P. Clean tank interior to prevent further off-gassing, as required to maintain vapor concentrations at ten (10) percent of lower explosive limit or below. Cleaning shall be performed in accordance with API RPs 2015 and 2016.

Q. After successfully purging/inerting the tank, the vent line shall be removed and a cap or plug shall be installed. The cap/plug shall have a one-quarter (1/4)-inch hole in it to allow additional venting and prevent over-pressurization of the tank.

R. Continue to excavate soils around the tank to permit removal. Petroleum-impacted soils and non-impacted soils must be segregated into separate piles. All excavated materials must be kept a minimum of two (2) feet from the edge of the excavation.

S. Contractor shall be responsible for the condition of the excavation. All slides and cave-ins shall be removed or corrected by the Contractor. The Contractor shall maintain the excavation open, safe, and water free until backfilling is authorized by the Engineer.

T. The Contractor shall be responsible for any sheeting, temporary bracing, and temporary supports that may be required to protect any structures or utilities outside and inside the limits of excavation and to permit safe entry by personnel to inspect for soil contamination. All excavation, trenching, and related sheeting, bracing, and/or supports shall comply with the requirements of OSHA excavation safety standards 29 CFR, Part 1926.650-652.

U. All excavations shall be shored and drained so that workers may work safely and efficiently. Contractor shall keep all excavations free from water. Dewatering of the excavation will be limited to that necessary to ensure adequate access to the UST and piping and to ensure safe excavation. Contractor shall provide for the disposal of the water removed from excavation in accordance with all applicable codes and regulations. Surface water shall be diverted to prevent direct entry into the excavation.

V. Remove the tank from the tank pit and place in a secure level area on site. The Contractor must only use equipment capable of safely lifting the tank. The tank shall not be dragged. The Contractor shall render the tank unfit for reuse by cutting holes in both ends, or by cutting the tank into scrap. If holes are cut into each end of the tank, the holes must be either squares or triangles with a minimum length of twenty-four (24) inches. All cutting shall be done in such a way, and using such tools and equipment, as to prevent generation of sparks or flame. Tanks shall not be cut-up or crushed on site if, in the opinion of the Engineer, this would pose a threat to public health or safety. In such a case, this work shall be done off site at a location approved by the Engineer (Contractor’s shop, scrap yard, etc.). The tank shall not be removed from the site until it has been inspected by MDE personnel.

W. Remove existing UST vent lines.

3.8 SUPPORT OF EXCAVATION

A. The Contractor shall be responsible for providing, maintaining, and removing temporary excavation support in accordance with MOSH. Detail drawings and design calculations for sheeting, shoring, and other temporary support of excavation and methods of construction shall be submitted for review and approval to the Engineer. The drawings shall bear the seal and signature of a Professional Engineer registered in the State of Maryland. The Contractor shall be solely responsible for the adequacy of the excavation supports, and for the safety of excavations.

3.9 HANDLING AND DISPOSAL OF EXCAVATED MATERIALS

A. The removed tank and associated ancillary equipment shall become the property of the Contractor, and transportation and disposal shall be in accordance with all federal, state, and local requirements.

B. The Contractor shall be responsible for safe and lawful manifesting, transportation, storage, and disposal of all waste materials and debris generated under this Contract. The Contractor will not sign non-hazardous or hazardous waste manifests on behalf of BCPM. BCPM will be provided documents by the Contractor for signature.

C. All concrete and asphalt paving removed during the tank removal activities shall be disposed off-site at an approved facility.

D. The Contractor shall submit to the Engineer copies of all Hazardous and/or Non-hazardous Waste Manifests for all solids and liquids generated during the tank removal activities that require disposal.

E. The Contractor shall submit copies to the Engineer of the Certification of acceptance recycling and treatment for cleaning of contaminated soils.

F. All excavated materials and imported fill materials shall be staged in accordance with proper E&S practices as detailed in these Contract Documents. This includes installation of silt fence on pavement around excavated material that is to be stored more than one (1) day or during rainy weather.

G. All excavated materials that will not be backfilled by the end of the workday shall be placed on double layers of six (6) mil or thicker polyethylene sheeting, at locations to be designated by the Engineer. Cover and securely anchor with polyethylene sheeting all soils at the end of the workday.

H. The Contractor shall control the grading so that the ground is pitched to prevent water from running to excavated areas, damaging other structures or adjacent properties. The Contractor shall ensure the protection of catch basins and public access areas from water runoff from the excavation areas of stockpiles, as well as provide erosion control.

I. Where soil has been softened or eroded by flooding or placement during unfavorable weather, it shall be removed and replaced with suitable material at no cost to BCPM.

J. The Contractor shall provide appropriate dust control measures, as directed by the Engineer.

3.10 BACKFILL MATERIALS

A. The UST excavation shall be backfilled with No. 57 stone approved by the Engineer. Previously contaminated soils that have been recycled or treated are not suitable backfill unless approved by the Engineer. Aggregate shall be used as backfill where shown on the Contract drawings.

B. By importing and placing fill materials at a site, the Contractor is certifying that the backfill material is “clean” and does not contain contaminants including but not limited to petroleum, heavy metals, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, solvents, volatile or semivolatile organic compounds, or any other contaminant above naturally occurring levels. Contractor shall follow applicable MDE regulations on clean fill and provide written certification to Engineer prior to Engineer’s approval. If any material used as backfill is found to be “contaminated,” the Contractor shall excavate and dispose

of the material, import and place new clean backfill material, and restore the site to its original condition, at no cost to the County.

C. Ensure that the bottom of the excavation (subgrade) is suitably compacted prior to beginning backfilling activities.

D. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces. If unsuitable materials are encountered during construction where concrete slabs or paving is to be placed, unsuitable materials are to be removed and replaced with tamped crusher run. The Engineer will determine suitability of subgrade for subsequent fill. Contractor shall provide equipment for proof-rolling of excavated subgrade.

E. The backfill shall be placed, uniformly spread, and compacted to maximum possible density. Maintain optimum moisture content of backfill materials to attain maximum compaction density (do not use water to increase density).

F. All backfilled materials shall be properly compacted in accordance with the Earth Moving specification and compact material in continuous horizontal layers not exceeding a loose thickness of eight (8) inches.

G. Employ a placement method that does not disturb or damage building foundations and/or utilities in excavation area.

H. Remove surplus backfill materials from site immediately following completion of backfill activities. All backfill materials staged on site are subject to the E&S measures detailed in these Contract Documents.

I. The Contractor shall take extreme care with backfill operations to ensure compaction to maximum possible density. At Engineer's discretion, the Contractor shall remove and re-install/replace backfill which is suspected of having less than maximum density. If compaction requirements for subgrade cannot be attained (the layer above the pea gravel), Contractor shall remove and re-install/replace subgrade and backfill at the State's request. All removal and reinstallation/replacement of pea gravel backfill and subgrade shall be done at BCPM's discretion and at no additional cost to the BCPM.

J. Any settling of concrete, asphalt pavement, or earth shall be corrected by the Contractor at no cost to the BCPM. All repair work shall be completed within five (5) business days after being notified of the issue.

3.11 SITE RESTORATION

A. After approval, backfill the excavation with approved material from the excavation process, supplemented by imported borrow, if necessary, and finish the surface as specified on Contract drawings.

B. The sawcut areas shall be restored to original grade and condition. Paving, sub-base, grading, topsoil, and landscape material replacement, etc. required for restoration shall be considered incidental to the applicable item(s) of work.

C. Contractor is responsible for repairing or replacing items damaged during tank closure activities, at no cost to BCPM.

3.12 TANK CLOSURE AND DISPOSAL DOCUMENTATION

A. A Tank Closure Report shall be prepared by the Contractor and submitted to the Engineer within thirty (30) days of UST removal at the Project site. The Tank Closure Report shall follow the MDE document titled "*Sample UST Closure Report Guidance*." For any additional documentation regarding tanks and any hazardous wastes, received after submittal of the Tank Closure Report, documentation shall be submitted within ten (10) days of receipt by the Contractor.

B. Final payment for the work will be withheld pending submission and approval of required destruction and disposal documentation. Tank closure reports shall include the following information at a minimum:

1. A cover letter signed by the Contractor certifying that all services involved have been performed in accordance with the terms and conditions of the Contract Documents.

2. A narrative report describing what was encountered at the site, including:

a. Condition and size of the UST removed;

b. Location of the UST on the property;

c. Any visible evidence of free product, leaks, or stained soils;

d. Results of vapor monitoring readings;

e. Actions taken including quantities of materials removed;

f. Collection data such as time of collection and method of preservation;

g. Reasons for backfilling site;

h. Whether or not groundwater was encountered, dewatering method, treatment used; and

i. Copies of all waste analysis/waste profile, manifests, and certification of final disposal by the responsible disposal facility official.

END OF SECTION 02 65 00

SECTION 02 81 00 – TRANSPORTATION AND REMOVAL OF HAZARDOUS MATERIALS

PART 1 - GENERAL

1.1 HAZARDOUS WASTE ABATEMENT AND DISPOSAL REGULATIONS

A. As new and revised regulations are published by governmental authorities, they become a part of this specification at the time of their effective date. All hazardous materials abatement packaging, transport, and disposal must be performed in strict compliance with all applicable local, state, and federal regulations, latest edition. The Contractor must maintain all licenses and certifications, in accordance with these regulations, which must be current for the entire term of this agreement.

1.2 ASBESTOS ABATEMENT WORK

A. Contractor must have an asbestos license and have certified asbestos abatement specialists. Individual workers must be trained through the contractor.

B. Reference Standards

1. Federal Standards, latest editions:

   a. Occupational Safety and Health Act of 1970, Public Law 91-596 (84 Stat. 15900).
   b. Federal Register of 18 Oct. 1972, as amended (29CFR 1910.1001).
   c. Clean Air Act, as amended Public Law 91-604 (84 Stat. 1676).
   d. Federal Register of 6 April 1973 (40CFR61:38FR8820).
   e. U.S. Department of Labor, Occupational Safety and Health Administration, General Industry-Safety and Health Standards, OSHA 2206 (Revised Jan. 1976) as modified in 29 CFP K 1910 et seq. 1977.
   f. Environmental Protection Agency Hazardous Waste Regulations and Consolidated Permit Regulation (40CFR 260-265 and 40CFR 122-125).

1. American National Standard Institute (ANSI):
   a. ANSI Z 9.2 – 1979 Design and Operation of Local Exhaust Systems.

2. Department of Health, Education and Welfare (DHEW)/National Institute for Occupational Safety and Health (NIOSH) Publications:
   a. DHEW (NIOSH Publication No. 79-127, February 1979 USPHS/NIOSH Membrane Filter Method for Evaluating Airborne Asbestos Fibers.

3. State of Maryland Department of Mental Hygiene Regulations:
   a. COMAR, TITLE 10, Subtitle 18, Chapter 15, Toxic Air Pollutants and COMAR, TITLE 10, Subtitle 18, Chapter 23, License to Remove or Encapsulate Asbestos.

A. Definitions

1. Hazardous Material: A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated

pursuant to the Hazardous Materials Transportation Act, 49 U.S.C. Appendix Section 1801 et seq. The term includes materials designated as hazardous materials under the provisions of 49 CFR 172, Sections .101 and .102 and materials which meet the defining criteria for hazard classes and divisions in 49 CFR 173. EPA designated hazardous wastes are also hazardous materials.

2. Hazardous Waste: A waste which meets criteria established in RCRA or specified by the EPA in 40 CFR 261 or which has been designated as hazardous by a RCRA authorized state program.

B. Submittals

1. Proof that the Contractor has been licensed and certified by the State of Maryland for asbestos removal. All licenses and certifications must be current.
2. Proof that employees have had instruction on the dangers of asbestos exposure, respirator use, decontamination, and OSHA regulations.
3. Written procedures for evacuation of injured workers. Aid for a seriously injured worker will not be delayed for reasons of decontamination.
4. Proof that all required permits, site location, and arrangements for transport and disposal of asbestos containing contaminated materials, supplies, and the like have been obtained.
5. A description of plans for construction of decontamination enclosure systems and for isolation of work areas in compliance with this specification and applicable regulations.

C. Posting Osha Regulations

1. The Contractor shall have at all times in his possession at his office (one copy) and in view at the job site (one copy), OSHA regulation 1910.1001, Asbestos, and Environmental Protection Agency 40 CFR part 61, Subpart B: National Emission Standards for asbestos, asbestos stripping work practices, and disposal of asbestos waste.

D. Worker's Dress & Equipment For Asbestos Removal

1. Work clothes shall consist of full body coverall, disposable head covers, boots, or sneakers, and respiratory protective equipment as required by OSHA regulations. Eye protection and hard hats should be available as appropriate.
2. Coveralls should be of a disposable paper type.
3. Respiratory protection for workers shall be provided by the Contractor as required by current OSHA regulations
4. The Contractor shall, at all times, have available for use by government representatives three (3) clean sets of safety equipment and clothing. This shall be stored in the clean room and be clearly marked FOR USE BY GOVERNMENT ONLY.

E. Decontamination

1. All workers without exception:
   a. Will change work clothes at designated areas prior to start of day's work. Lockers or acceptable substitutes will be provided by the Contractor for street and work clothes.
   b. Will remove all work clothes in work area prior to departure from this area. Workers should then proceed to showers. Workers will shower before lunch and at end of each day's work. Hot water, towels, soap and hygienic conditions are the responsibility of the Contractor.
   c. Will not smoke, eat or drink once beyond the clean room at the job site. Prior to

smoking, eating or drinking, workers will fully decontaminate by showering. Each worker will then dress into a new clean disposable coverall to eat, smoke, or drink. This new cover can be used to re-enter the work area.

d. Will leave work footwear inside work area until completion of job.

F. Pre-Asbestos Removal Preparation
1. The Contractor will remove and dispose of all rubbish and debris from floor of work area first.
2. The Contractor shall thoroughly seal all openings and fixtures including, but not limited to, heating and ventilation ducts, doors, windows, and lighting with polyethylene taped securely in place.
3. Polyethylene sheets (6 mil minimum) will be used to cover entire floor and wall surfaces. Polyethylene sheets shall be used to cover all items left in place and not practical to move. Polyethylene shall be sealed so that it is secured in place during removal operations.
4. The Contractor shall set up a decontamination facility in an area pre-designated by the CCI, which will house the changing room, portable showers, toilets and equipment.

G. Methods of Asbestos Removal
1. Asbestos abatement work shall not commence until arrangements have been made for disposal of waste at an acceptable site. The site must be identified prior to the start of work and must be approved by the PMDM or PAI.
2. The asbestos material will be sprayed with water containing an additive to enhance penetration. The additive or wetting agent will be 50% polyethylene-ester and 50% polyoxyethylene-ester at a concentration of 1 ounce per 5 gallons of water. A fine spray of this solution must be applied to prevent fiber disturbance preceding removal of asbestos material. The asbestos will be sufficiently saturated to prevent emission of airborne fibers in excess of exposure limits prescribed in the OSHA standards referenced in these specifications.
3. Removal of asbestos material will be done in small sections with two person teams, on staging platforms, if needed. Material will be packed into sealable plastic bags of 6 mil minimum thickness and place in labeled containers for transport. Place caution labels on containers in accordance with EPA Standards and OSHA Regulation 29 CFR 1910.1001 (g)(2).
4. Clean external surfaces of containers thoroughly by wet sponging in designated area of the work area which is part of the equipment decontamination enclosure system. Move containers to washroom, wet clean each container thoroughly, and move to holding area pending removal to uncontaminated areas. Insure that containers are removed from holding area by workers who entered from uncontaminated areas dressed in clean coveralls.
5. Remove visible accumulations of asbestos material and debris. Wet clean all surfaces within work area.
6. Remove plastic sheets from walls and floors, windows and doors.
7. Clean all surfaces in work area and any other contaminated area with water. After cleaning work area, wait 24 hours to allow for settlement of dust, and again wet clean all surfaces in work area. After completion of second cleaning operation, perform a complete visual inspection of work area to ensure that work area is dust free.
8. All polyethylene material, tape, cleaning material, and clothing will be placed in plastic lined drums, sealed and labeled as described above for asbestos waste material.
9. All equipment at facility will be cleaned of asbestos material prior to leaving work area. Any damage to equipment and other items shall be repaired to original condition at no cost to the Government.

H. Air Monitoring
1. Throughout removal and cleaning operations, air sample monitoring will be conducted to ensure that the Contractor is complying with all codes, regulations and ordinances. The method to be used is described in OSHA Standards 1919.939.
2. Air monitoring will be performed to provide the following samples (per week) during the period of asbestos removal:

Areas	Samples	Min. Sample Vol.
Work Area	4	60
Outside	2	120
Outside Bldg.	2	240

3. Samples will be taken after the actual removal operation has begun.
4. Baltimore County shall provide the air monitoring firm for sampling, testing and reporting.

I. Clean-Up Guarantee
1. After the second cleaning operation, the following test should be performed: A complete visual inspection should be made to insure dust free conditions, and two air samples within 48 hours after completion of all cleaning work should be taken. (Minimum volume of air sample 240 liters).
2. If non-compliance occurs, repeat cleaning and measurement until space is in compliance. Refer to 26 CFR 1910.1001, 7A.

J. Disposal Of Asbestos Material and Related Debris
1. All asbestos materials and miscellaneous debris in sealed drums will be transported to pre-designated disposal sites in accordance with guidelines and requirements to the U.S. Environmental Protection Agency and applicable State and local jurisdictions.
2. Workers unloading sealed drums and machinery operators will wear respirators when handling material at disposal site.
3. Bags may be dumped from drums into burial site. Drums may be reused; however, if a bag is broken or damaged, the entire drum shall be buried.
4. Contractor shall be responsible for all storage disposal, transportation, and removal permits (re: State or District, EPA, etc.).

K. Violations
1. If, at any time, the Contracting Officer decides that work practice is violating pertinent regulations or endangering workers, he will immediately notify in writing the on-site Contractor representative that operations will cease until corrective action is taken.

1.3 HAZARDOUS WASTE REMOVAL AND DISPOSAL

A. Certification
1. All bidders shall be Environmental Protection Agency and Maryland State certified hazardous waste haulers. A copy of the hauler's certification, which must be current, must be provided prior to the award of the contract.

B. Packing
1. The hazardous waste must be transported in suitable, Federal DOT approved, 55 gallon drum containers that shall preclude the loss of any of the material to the environment. The containers shall comply with all Federal Department of Transportation regulations. The Contractor shall provide all containers and all vermiculite packing materials. The

Contractor must properly label each container with a label approved by the Federal Department of Transportation.

C. Licenses – Hazardous Waste
   1. The successful bidder must submit, prior to award of contract, Maryland Certified Haulers License, Certified Licensing for all trucks proposed for participation in the hauling process, Certified Haulers Licenses for all other additional haulers and their trucks involved during the course of this agreement, and Certified Disposal Site Licenses for the disposal/destruction locations to be employed during the term of this agreement.

D. Permits And Manifesting
   1. The Contractor shall be responsible for obtaining all necessary permits. All manifests required for hauling and disposal of materials must be prepared by the Contractor and are subject to review and approval by the Baltimore County Department of Environmental Protection and Sustainability (DEPS). A copy of each manifest shall be sent to the PMDM or PAI

E. Disposal
   1. The disposal facility shall be an Environmental Protection Agency approved treatment and storage or disposal facility. The Contractor must supply to the County a Certificate of Disposal and Destruction and a copy of the completed manifest (signed off by all handlers of the waste) for each shipment of hazardous waste generated under this contract. No invoices shall be paid by Baltimore County until both documents have been provided by the Contractor to the Property Management Division Manager, or his authorized representative.

F. Removal
   1. Pick-ups must be made within ten (10) calendar days after mobilization on site by the Contractor.

G. Placarding
   1 Certified vehicles shall display a Hazardous Waste Transporter Vehicle Certification Sticker on the outside of the left door of the cab, either on the door immediately below the window or immediately forward of the door at approximately the same elevation. If the vehicle is a combination vehicle, the sticker shall be prominently displayed on the left side of the trailer and must not be obstructed from view by other markings, attachments, or equipment.
   2 The vehicle operator shall compare labels and manifest to insure that the contents and quantities listed on the manifest are the same as those listed on the containers. Any discrepancies must be corrected.

H. Spills
   1. In the event of a spill or loss of hazardous waste to the environment, any person engaged in the transportation of the waste shall not knowingly fail to report the incident immediately (within one hour) by phoning the Maryland Department of the Environment at (410) 974-3512 and the Baltimore County Fire Department (410) 887-4592. The person and vehicle involved must remain at the scene and available until clearance to leave is given by the appropriate officials. A copy of the Oil/Chemical Spills emergency numbers card must be carried in the vehicle transporting hazardous waste.

1.4 HAZARDOUS WASTE – LIGHT BALLASTS PCB REMOVAL

A. General
1. Small capacitors and fluorescent light ballasts manufactured after 1978 have been labeled “NO PCB’s” by the manufacturers. Prior to 1978, small capacitors and fluorescent light ballasts were not labeled as to whether they contained PCB; therefore, all unlabeled capacitors and ballasts shall be assumed to contain PCB.
2. Hereunder, all ballasts not labeled “NO PCB’s” will be considered to contain PCB and shall be removed and incinerated of as such. The following procedures have been developed to assure proper incineration of small capacitors and fluorescent light ballasts. *Note* All light ballasts that do not have “NO PCB’s “written on them, and all PCB contaminated materials are to be incinerated.

B. References
1. Code of Federal Regulations (CFR):
a. 29 CFR 1910, Occupational Safety and Health Act, General Industry.
b. 29 CFR 1926, Occupational Safety and Health Act, Construction Industry. 40 CFR 761, U.S. Environmental Protection Agency Regulations for PCB. 29 CFR 1910.120, OSHA General Industry, Hazardous Waste Operations Requirements.
2. Department of Transportation Regulations (DOT): 49 CFR Part 178.
3. State Regulations: Maryland Controlled Hazardous Substances (CHS) Regulations (COMAR 26.13.01.)

C. Contractor Responsibility
1. Compliance: The Contractor shall assume full responsibility and liability for compliance with all applicable Federal, State, and Local regulations pertaining to the protection of his workers, visitors to the site, and persons occupying areas adjacent to the site. The Contractor shall hold the government harmless for failure to comply with any applicable safety or health regulation on the part of himself, his employees, or his subcontractors.
2. Medical Review: The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable Federal, State, and local regulations.

D. Preparation
1. Isolate the PCB area for the duration of the work so as to prevent unauthorized access by designating the area off limits to all but authorized personnel. Maintain a log of all persons visiting the PCB work site.
2. Post warning signs and labels as required by this contract 29, CFR 1910, 40 CFR 761, and as directed by the Baltimore County Government’s representative.

E. Work Procedure
1. General Procedures: Perform all PCB related work and comply with the general safety and health provisions in conformance with 29 CFR 19810, 29 CFR 1926, and 40 CFR, respectively. If a conflict arises, the more stringent application shall apply until a determination is made by the Baltimore County Government’s representative.
2. Coordination of Work of all Trades: Coordinate the work of all trades to assure that their work is performed in accordance with the applicable regulations and that the PCB control area remains separated from the remaining work areas.

F. Equipment
1. Equipment, including disposable protective clothing, i.e., type suits, respirator with filters NIOSH & OSHA approved to work with PCB’s rubber gloves, etc. All equipment shall be used in the execution of this contract and be provided to visitors to the site. The equipment shall also comply with all applicable Federal, State and local regulations.

G. Field Quality Control

1. Site Inspection and Stop Work Orders: While performing this work, the Contractor shall be subject to onsite inspection by agency officials or agency contracted inspection services. Work shall also be subject to inspection by OSHA and EPA inspectors and/or State building or health officials. If found to be in violation by one of these officials, the Contractor shall cease all work immediately. Until the violation is resolved, standby time required to resolve the violation shall be at the Contractor's expense.
2. One complete set of equipment (such as respirators and disposable clothing) required for entry to the work area shall be made available within 2 hours of request by the Baltimore County Government's representative for inspection of work area. Such requests will only be made during normal working hours.

H. Cleanup and Disposal
1. Permits and Notifications: Secure necessary permits in conjunction with PCB removal, hauling and disposition and provide timely notification of such actions, as may be required by Federal authorities. Notify the Office of the United States Environmental Protection Agency and provide copies of the notification to the Baltimore County Government's representative 10 days prior to the commencement of the work.
2. Housekeeping: Essential parts of PCB control are housekeeping and cleanup procedures. Maintain all surfaces on the work area free of accumulation of debris to prevent further dispersion. Give meticulous attention to restricting the spread of debris, keep waste from being distributed over the general area or to other areas in the building. The blowing down of the work area with compressed air is forbidden. Post appropriate hazard warning signs. In all possible instances, workmen shall cleanup their own areas. Provide personnel in cleaning scrap and waste with personal protective clothing.
3. Incineration of PCB Containing Materials: Collect and dispose of all PCB Ballasts and contaminated waste, rags, scrap, debris, bags, containers, equipment, and PCB contaminated clothing in properly labeled PCB disposal drums. Waste PCB containing material shall be transported to an incineration site. The Contractor will provide the Baltimore County Government's representative with a copy of all manifests and continuation sheets resulting from the incineration of the PCB containing waste. In some instances, a temporary holding area can be established upon approval by the Baltimore County Government's representative for properly packaged PCB waste.

1.5 HAZARDOUS WASTE – POLE MOUNTED TRANSFORMER PCB REMOVAL

A. References
1. Code of Federal Regulations (CFR):
   a. 29 CFR 1910, Occupational Safety and Health Act, General Industry.
   b. 29 CFR 1926, Occupational Safety and Health Act, Construction Industry. 40 CFR 761, U.S. Environmental Protection Agency Regulations for PCB. 29 CFR 1910.120, OSHA General Industry, Hazardous Waste Operations Requirements.
2. Department of Transportation Regulations (DOT): 49 CFR Part 178.
3. State Regulations: Maryland Controlled Hazardous Substances (CHS) Regulations (COMAR 26.13.01.)

A. Contractor Responsibility
1. Compliance: The Contractor shall assume full responsibility and liability for compliance with all applicable Federal, State, and Local regulations pertaining to the protection of his workers, visitors to the site, and persons occupying areas adjacent to the site. The Contractor shall hold the government harmless for failure to comply with any applicable safety or health regulation on the part of himself, his employees, or his subcontractors.
2. Medical Review: The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable Federal, State, and local regulations.

B. Equipment

1. Equipment, including disposable protective clothing, i.e., type suits, respirator with filters NIOSH & OSHA approved to work with PCB's rubber gloves, etc. All equipment shall be used in the execution of this contract and be provided to visitors to the site. The equipment shall also comply with all applicable Federal, State and local regulations.

C. Preparation

1. Isolate the PCB area for the duration of the work so as to prevent unauthorized access by designating the area off limits to all but authorized personnel. Maintain a log of all persons visiting the PCB work site.
2. Post warning signs and labels as required by this contract 29, CFR 1910, 40 CFR 761, and as directed by the Baltimore County Government's representative.

D. Work Procedure

1. General Procedures: Perform all PCB related work and comply with the general safety and health provisions in conformance with 29 CFR 1910, 29 CFR 1926, and 40 CFR, respectively. If a conflict arises, the more stringent application shall apply until a determination is made by the Baltimore County Government's representative.
2. Coordination of Work of all Trades: Coordinate the work of all trades to assure that their work is performed in accordance with the applicable regulations and that the PCB control area remains separated from the remaining work areas.

E. Transformer Removal

1. The following is a basic outline of the minimum steps that will be taken during the removal of PCB containing transformers. The procedure, plan of action, submitted for approval by the Contractor should address these points:
   a. The Contractor shall assure that all power to the poles has been cut off.
   b. The Contractor will prepare to dismantle each transformer and lower to the ground by wrapping 6 mil polyethylene or equivalent around the transformer and secure prior to lower from the pole.
   c. Lower transformer to the ground in preparation of draining PCB fluids.
   d. The PCB fluid inside transformers must be drained and containerized in accordance with COMAR 26.13.02.19.
   e. Disposal of this material will be in accordance with COMAR. Any concentrations or fluids testing greater than 50 ppm are considered PCB containing.
   f. Handling of this fluid must be by persons trained and certified in the 40 hour OSHA Hazardous Materials Worker Training Program.
   g. Disposal of this material must be in accordance with COMAR 26.13.02.19.

F. Field Quality Control

1. Site Inspection and Stop Work Orders: While performing this work, the Contractor shall be subject to onsite inspection by agency officials or agency contracted inspection services. Work shall also be subject to inspection by OSHA and EPA inspectors and/or State building or health officials. If found to be in violation by one of these officials, the Contractor shall cease all work immediately. Until the violation is resolved, standby time required to resolve the violation shall be at the Contractor's expense.
2. One complete set of equipment (such as respirators and disposable clothing) required for entry to the work area shall be made available within 2 hours of request by the Baltimore County Government's representative for inspection of work area. Such requests will only be made during normal working hours.

G. Cleanup and Disposal

1. Permits and Notifications: Secure necessary permits in conjunction with PCB removal, hauling and disposition and provide timely notification of such actions, as may be required by Federal authorities. Notify the office of the United States Environmental Protection Agency and provide copies of the notification to the Baltimore County Govern-

ment's representative 10 days prior to the commencement of the work.

2. Incineration of PCB Containing Materials: Collect and dispose of all PCB containers, equipment, and PCB contaminated clothing in properly labeled PCB disposal drums. Waste PCB containing material shall be transported to an incineration site. The Contractor will provide the Baltimore County Government's representative with a copy of all manifests and continuation sheets resulting from the incineration of the PCB containing waste. In some instances, a temporary holding area can be established upon approval by the Baltimore County Government's representative for properly packaged PCB waste.

1.6 LEAD ABATEMENT WORK

A. General
   1. The Contractor shall assure Baltimore County that all lead-contaminated waste, scrap and debris is handled, stored, transported and disposed of in accordance with EPA, State and local regulatory agency requirements, latest editions.

B. Related Work
   1. Title to Materials: Materials resulting from demolition work, except as specified otherwise, shall become the property of the Contractor, and shall be disposed of in accordance with the methods specified herein.

C. References
   1. Code of Federal Regulations (CFR):
      a. 29 CFR 1910, Occupational Safety and Health Act, General Industry.
      b. 29 CFR 1926, Occupational Safety and Health Act, Construction Industry.
      c. 29 CFR 1910.120, OSHA General Industry, Hazardous Waste Operations Requirements.
   2. Department of Transportation Regulations (DOT): 49 CFR Part 178.
   3. State Regulations: Maryland Controlled Hazardous Substances (CHS) Regulations (COMAR 26.13.01.)

D. Contractor Responsibility
   1. Compliance: The Contractor shall assume full responsibility and liability for compliance with all applicable Federal, State, and Local regulations pertaining to the protection of his workers, visitors to the site, and persons occupying areas adjacent to the site. The Contractor shall hold the government harmless for failure to comply with any applicable safety or health regulation on the part of himself, his employees, or his subcontractors.
   2. Medical Review: The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable Federal, State, and local regulations.
   3. Air quality during the demolition process shall be monitored for air-born lead content and shall be in accordance with EPA, State and local regulations and requirements.

E. Work Procedure
   1. Lead contaminated waste, scrap, and debris shall be disposed of as follows:
      Lead contaminated waste, scrap, debris, bags, containers, equipment and lead- contaminated clothing, which may produce airborne concentrations of lead particles shall be stored in U.S. Department of Transportation CFR 49 Part 178 approved 200 liter (55 gallon) drums. Each drum shall be labeled to identify the type of waste as defined in CFR 49 Part 172 and the date lead-contaminated wastes were first put into the drum. The Uniform Hazardous Waste Manifest forms from the Federal and State agencies shall be obtained and completed. Land disposal restriction notifications shall be as required by CFR 40 Part 268. The Owner's Representative shall be notified at least 14 days prior to delivery to arrange for job site inspection of the drums and manifests. Lot deliveries of hazardous wastes shall be made as needed to ensure that drums do not remain on the work

site longer than 90 calendar days from the date affixed to each drum.
The Contracting Officer will assign an area for interim storage of waste-containing drums.

2. Lead-contaminated waste shall be handled, stored, transported, and disposed of in accordance with CFR 40 Part 260, CFR 40 Part 261, CFR 40 Part 262, CFR 40 Part 263, CFR 40 Part 264, and CFR 40 Part 265, land disposal restriction notification shall be as required by CFR 40 Part 268.

F. Field Quality Control
1. Site Inspection and Stop Work Orders: While performing this work, the Contractor shall be subject to onsite inspection by agency officials or agency contracted inspection services. Work shall also be subject to inspection by OSHA and EPA inspectors and/or State building or health officials. If found to be in violation by one of these officials, the Contractor shall cease all work immediately. Until the violation is resolved, standby time required to resolve the violation shall be at the Contractor's expense.
2. One complete set of equipment (such as respirators and disposable clothing) required for entry to the work area shall be made available within 2 hours of request by the Baltimore County Government's representative for inspection of work area. Such requests will only be made during normal working hours.

G. Cleanup and Disposal
1. Permits and Notifications: Secure necessary permits in conjunction with lead contaminated materials removal, hauling and disposition and provide timely notification of such actions, as may be required by Federal authorities. Notify the Office of the United States Environmental Protection Agency and provide copies of the notification to the Baltimore County Government's representative 10 days prior to the commencement of the work.
2. Toxicity Characteristic Leaching Procedure (TCLP) Results: The results of the TCLP analysis performed during abatement shall be used to determine disposal procedures.
3. Disposal Documentation: Written evidence shall be provided that the hazardous waste treatment, storage, or disposal facility is approved for lead disposal by the EPA and State or local regulatory agencies. One copy shall be submitted of the complete manifest; signed, and dated by the initial transporter in accordance with CFR 40 part 262.
4. Payment for Hazardous Waste: Payment for disposal of hazardous waste will not be made until a signed copy of the manifest from the treatment or disposal facility certifying the amount of lead-containing materials delivered is returned and a copy is furnished to the Property Management Division Manager, or his authorized representative.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 MEASURE AND PAYMENT

A. Track loader, minimum 3 cubic yard bucket, paid for by the hour, includes operator, fuel, vital fluids, full maintenance and repair.

B. Bulldozer, minimum 8' blade, paid for by the hour, includes operator, fuel, vital fluids, full maintenance and repair.

C. Excavators with one (1) bucket, and grapple, and one (1) with mechanical pulverizer, min-

imum 70,000 lb. Capacity, paid for by the hour, includes operator, fuel, vital fluids, full maintenance and repair.

D. Truck, single axle dump, tandem axle dump, and tractor trailer dump, paid for by the hour, one (1) hour total travel time allowed for both Contractor's yard to job site and dump to Contractor's yard, from job site to dump and dump to job site; includes operator, fuel, vital fluids, and full maintenance and repair. The PMDM or PAI, or his authorized representative, must approve the dump site to be used by the Contractor for each job.

E. Dumping charges – paid for by the cubic yard, for construction debris/rubble landfill, concrete/blacktop reclamation operation, asbestos and asbestos contaminated material landfill, contaminated soil (by fuel) landfill.

F. Borrowed material – paid for by the cubic yard, furnished and installed.

G. Grounds restoration – paid for by the square foot, furnished and installed, topsoil, grass seed, straw mulch, hydroseeding with fiber mulch. The contaminated soil test is paid for by the each and includes all costs associated with the test.

H. Backhoe, rubber tired, minimum 24" bucket, and skid steer, minimum 50HP, paid for by the hour, includes operator, fuel, vital fluids, full maintenance and repair.

I. Excavator high reach, 70' reach, universal processor, pulverizer/shear, paid for by the hour, includes operator, fuel, vital fluids, full maintenance and repair.

J. Mobilization, for track loader, bulldozer, excavators, backhoe, skid steer, and high reach excavator, individually paid once per job site.

K. Capping of well by licensed well driller, paid for per well.

END OF SECTION 02 41 16

SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Formwork for cast-in-place concrete, with shoring, bracing and anchorage.

B. Openings for other work.

C. Form accessories.

D. Form stripping.

1.2 REFERENCE STANDARDS

A. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials; American Concrete Institute.

B. ACI 301 – Specifications for Structural Concrete for Buildings; American Concrete Institute.

C. ACI 318 – Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute.

D. ACI 347 – Guide to Formwork for Concrete; American Concrete Institute.

E. ASME A17.1 – Safety Code for Elevators and Escalators; The American Society of Mechanical Engineers.

1.3 SUBMITTALS

A. See Section 01 33 00 – Submittal Procedues.

B. Product Data: Provide data on void form materials.

C. Shop Drawings: Indicate pertinent dimensions, materials, bracing and arrangement of joints and ties.

1. Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork. Shop drawings shall be signed and sealed by an engineer registered in the local jurisdiction.
2. Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.
3. Indicate location of all slab joint types.

1.4 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 347, ACI 301, and ACI 318.

1. Maintain one copy of standards on project site.

PART 2 - PRODUCTS

2.1 FORMWORK – GENERAL

A. Provide concrete forms, accessories, shoring and bracing as required to accomplish cast-in-place concrete work.

B. Design and construct to provide resultant concrete that conforms to design with respect to shape, lines, and dimensions.

C. Comply with applicable State and local codes with respect to design, fabrication, erection, and removal of formwork.

D. Comply with relevant portions of ACI 347, ACI 301 and ACI 318.

2.2 WOOD FORM MATERIALS

A. Form Materials: At the discretion of the Contractor.

2.3 PREFABRICATED FORMS

A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

C. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set; 2 inches thick.

2.4 FORMWORK ACCESSORIES

A. Form Ties: Snap-off type, galvanized metal, fixed length, cone type, with waterproofing washer, 1 inch back break dimension, free of defects that could leave holes larger than 1 inch in concrete surface.

B. Form Release Agent: Colorless mineral oil that will not stain concrete, absorb moisture, impair natural bonding of concrete finish coatings, or affect color characteristics of concrete finish coatings.

C. Corners: Chamfered, rigid plastic or wood strip type, ¾ x ¾ inch size, maximum possible lengths.

D. Dovetail Anchor Slot: Galvanized steel, 22 gage thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

E. Flashing Reglets: Galvanized steel, 22 gage thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

F. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

G. Waterstops: Preformed mineral colloid strips, ¾ inch thick, moisture expanding.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.2 EARTH FORMS

A. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

3.3 ERECTION – FORMWORK

A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

C. Provide chamfer strips on external corners of beams, joists, and columns.

D. Install void forms in accordance with manufacturer’s recommendations. Protect forms from moisture or crushing.

E. Coordinate this section with other sections of work that require attachment of components to formwork.

F. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect before proceeding.

3.4 APPLICATION – FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer’s recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.5 INSERTS, EMBEDDED PARTS AND OPENINGS

A. Provide formed openings where required for items to be embedded or passing through concrete work.

B. Locate and set in place items that will be cast directly into concrete.

C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

D. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement.

F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.6 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.

1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
2. During cold weather, remove ice and snow from within forms. Do not use deicing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.7 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 117, unless more stringent tolerances are required within the contract documents.

B. Construct and align formwork for elevator hoistway in accordance with ASME A17.1.

3.8 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Division 1. Inspection services shall conform to the Statement of Special Inspections noted in the structural drawings.

B. Inspect erected formwork, shoring and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

C. Do not reuse wood formwork more than 3 times for concrete surfaces to be exposed to view. Do not patch formwork.

3.9 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finished concrete surfaces scheduled for exposure to view.

C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

END OF SECTION 03 10 00

SECTION 03 20 00 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Reinforcing steel for cast-in-place concrete.

B. Supports and accessories for steel reinforcement.

1.2 REFERENCE STANDARDS

A. ACI 301 – Specifications for Structural Concrete for Buildings; American Concrete Institute.

B. ACI 318 – Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute.

C. ACI SP-66 – ACI Detailing Manual; American Concrete Institute.

D. ASTM A 615/A 615M – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

E. ASTM A 1064/A 1064M – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain, Deformed, for Concrete.

F. CRSI (DA4) – Manual of Standard Practice; Concrete Reinforcing Steel Institute.

G. CRSI (P1) – Placing Reinforcing Bars; Concrete Reinforcing Steel Institute.

1.3 SUBMITTALS

A. See Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.

C. Manufacturer’s Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.

D. Reports: Submit certified copies of mill test report of reinforcement materials analysis.

E. LEED Submittals: Comply with Section 01 81 13.

1. MR Credit 2: Environmental Product Declarations

a. Steel reinforcement

1.4 QUALITY ASSURANCE

A. Perform work of this section in accordance with CRSI (DA4), CRSI (P1), ACI 301, ACI SP-66, and ACI 318.

1. Maintain one copy of each document on the project site.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420).

1. Deformed billet-steel bars.
2. Unfinished.

B. Steel Welded Wire Reinforcement: ASTM A 1064/A 1064M, plain type.

1. Flat sheets.
2. Mesh Size and Wire Gage: As indicated on drawings.

C. Reinforcement Accessories:

1. Tie Wire: Annealed, minimum 16 gage.
2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
3. Supports and Spacers in Contact with the Ground:

a. Precast concrete supports with a surface area of not less than 4 in^2, a compressive strength equal to or greater than the specified compressive strength of the concrete being placed, and embedded tie wires for securing the reinforcement.
b. Chairs with plastic components and sand plates.
c. Spacers: Plastic.

4. Provide stainless steel components for placement within 1½ inches of weathering surfaces.

2.2 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI (DA4) – Manual of Standard Practice.

B. Welding of reinforcement is not permitted.

C. Locate reinforcing splices not indicated on drawings at point of minimum stress.

1. Review location of splices with Architect.

PART 3 - EXECUTION

3.1 PLACEMENT

A. Place, support, and secure reinforcement against displacement before and during concrete placement. Do not deviate from required position.

B. Clean reinforcement of loose rust, mill scale, earth, ice and other foreign materials that would reduce bond to concrete.

C. Do not displace or damage vapor barrier.

D. Accommodate placement of formed openings.

E. Conform to structural drawings for concrete cover over reinforcement.

3.2 FIELD QUALITY CONTROL

A. An independent inspection agency, as specified in Division 1, will inspect installed reinforcement for conformance to contract documents before placing concrete. Inspection services shall conform to the Statement of Special Inspections noted in the structural drawings.

END OF SECTION 03 20 00

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete for composite floor construction.

B. Floors and slabs on grade.

C. Concrete foundation walls and building walls.

D. Footings.

E. Columns and piers.

F. Joint devices associated with concrete work.

G. Miscellaneous concrete elements, including equipment pads.

1.2 RELATED REQUIREMENTS

A. Section 03 10 00 – Concrete Forming and Accessories.

B. Section 03 20 00 – Concrete Reinforcing.

C. Section 03 35 13 – High Tolerance Concrete Floor Finishing.

D. Section 03 39 00 – Concrete Curing.

E. Section 07 95 13 – Expansion Joint Cover Assemblies.

F. Section 07 90 05 – Joint Sealers.

1.3 REFERENCE STANDARDS

A. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute.

B. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete; American Concrete Institute.

C. ACI 301 – Specifications for Structural Concrete for Buildings; American Concrete Institute.

D. ACI 302.1R – Guide for Concrete Floor and Slab Construction; American Concrete Institute.

E. ACI 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute.

F. ACI 305R – Hot Weather Concreting; American Concrete Institute.

G. ACI 306R – Cold Weather Concreting: American Concrete Institute.

H. ACI 318 – Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute.

I. ASTM C 33 – Standard Specification for Concrete Aggregates.

J. ASTM C 39/C 39M – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

K. ASTM C 94/C 94M – Standard Specification for Ready-Mixed Concrete.

L. ASTM C 150 – Standard Specification for Portland Cement.

M. ASTM C 173/C 173M – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

N. ASTM C 260 – Standard Specification for Air-Entraining Admixtures for Concrete.

O. ASTM C 330 – Standard Specification for Lightweight Aggregates for Structural Concrete.

P. ASTM C 494/ C 494M – Standard Specification for Chemical Admixtures for Concrete.

Q. ASTM C 618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

R. ASTM C 881/C 881M – Standard Specification for Epoxy-Resin Base Bonding Systems for Concrete.

S. ASTM C 989 – Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.

T. ASTM C 1077 – Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

U. ASTM C 1107/C 1107M – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).

V. ASTM C 1240 – Standard Specification for Silica Fume Used in Cementitious Mixtures.

W. ASTM D 1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types).

X. ASTM E 96 – Standard Test Methods for Water Vapor Transmission of Materials.

Y. ASTM E 329 – Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials used in Construction.

Z. IBC 2021 – International Building Code.

1.4 SUBMITTALS

A. See Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's data on manufactured products showing compliance with specified requirements.

C. Samples: Submit samples of under-slab vapor retarder to be used.

D. Design Mixtures:

1. Submit for each concrete mixture.
2. Submit alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
3. Indicate amounts of mixing water to be withheld for later addition at project site.

E. LEED Submittals: Comply with Section 01 81 13.

1. MR Credit 2: Environmental Product Declarations.

a. Concrete, slag, cement.

1.5 QUALITY ASSURANCE

A. Concrete Producer: Engage a firm with experience in producing concrete similar to that indicated for this project and within 15 percent of this project size, with a record of successful in-service performance as well as sufficient production capacity to supply concrete without delaying the work.

1. Provide documentation that concrete producer has supplied concrete for at least 3 projects within 15 percent of project size and complexity in the last six years.

B. Concrete Contractor: Engage a firm with experience in placing and finishing concrete similar to that indicated for this project and within 15 percent of this project size, with a record of successful in-service performance.

1. Provide documentation that the concrete contractor has installed concrete for at least 3 projects within 15 percent of project size and complexity in the last six years.

C. Perform work of this section in accordance with ACI 301 and ACI 318.

1. Maintain one copy of each document on site.

D. Follow recommendations of ACI 305R when concreting during hot weather.

E. Follow recommendations of ACI 306R when concreting during cold weather.

F. All form release agents and membrane curing compounds used for slabs and walls that are to be waterproofed shall be submitted to the manufacturer of hot fluid waterproofing system for compatibility review prior to application.

G. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1.
2. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

PART 2 - PRODUCTS

2.1 FORMWORK

A. Comply with requirements of Section 03 10 00.

2.2 REINFORCEMENT

A. Comply with requirements of Section 03 20 00.

2.3 CONCRETE MATERIALS

A. Cement: Acquire from the same source and use same type for entire Project.

1. Portland Cement: ASTM C 150, Type 1.
2. Blended Hydraulic Cement: ASTM C 595, Type IL, Portland-limestone.

B. Fine and Coarse Aggregates: ASTM C 33.

1. Acquire all aggregates for entire project from same source.

C. Lightweight Aggregate: ASTM C 330.

D. Ground Granulated Blast Furnace Slag: ASTM C 989, Grade 100 or 120.

E. Fly Ash: ASTM C 618 Class F.

F. Calcined Pozzolan: ASTM C 618 Class N.

G. Silica Fume: ASTM C 1240.

H. Water: Clean and not detrimental to concrete.

2.4 CHEMICAL ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

B. Air Entrainment Admixture: ASTM C 260.

C. High Range Water Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.

D. High Range Water Reducing Admixture: ASTM C 494/C 494M, Type F.

E. Water Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.

F. Water Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

G. Accelerating Admixture: ASTM C 494/C 494M, Type C.

H. Retarding Admixture: ASTM C 494/C 494M, Type B.

I. Water Reducing Admixture: ASTM C 494/C 494M, Type A.

2.5 ACCESSORY MATERIALS

A. Underslab Vapor Barrier / Vapor Retarder: Comply with ASTM E 1745, Class A.

1. Maximum Permeance ASTM E 96: 0.018 perms (English).
2. Provide standard accessories and tape for complete system.
3. Acceptable Products:

    a. Stego Wrap (15-mil) Vapor Barrier by Stego Industries LLC.
    b. Perminator: 15 mils by W.R. Meadows, Inc.
    c. 15 Mil Green by Reef Industries, Inc.
    d. Vapor Block 15 by Raven Industries.
    e. Yellow Guard 15-mil Vapor Barrier by Poly-America.

4. Single ply polyethylene is prohibited.

B. Non-Shrink Grout: ASTM C 1107/C 1107M; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.

1. Minimum Compressive Strength at 48 Hours: 2,400 psi.
2. Minimum Compressive Strength at 28 Days: 7,000 psi.

C. Curing Materials: Comply with requirements of Section 03 39 00.

2.6 BONDING AND JOINTING PRODUCTS

A. Bonding Agent: Epoxy bonding system complying with ASTM C 881/C 881M and of Type required for specific application.

B. Waterproofing Admixture Slurry: Slurry coat of Portland cement, sand, and crystalline waterproofing additive, mixed with water in proportions recommended by manufacturer to achieve waterproofing at cold joints in concrete.

1. Manufacturers:

    a. Aquafin, Inc.: www.aquafin.net.
    b. Xypex Chemical Corporation: www.xypen.com.
    c. Kryton International Inc: www.kryton.com.

C. Self-Expanding Strip Waterstops: Manufactured rectangular or trapezoidal strip, sodium bentonite or other hydrophilic material for adhesive bonding to concrete.

1. Available Products:

    a. CETCO Waterstop-RX: Mineral Technologies Inc.
    b. Conseal CS-231: Concrete Sealants Inc.
    c. De Neef Swellseal Joint: GCP Applied Technologies
    d. Hydrotite CJ: Sika Corporation.
    e. Mirastop BW: Henry Corporation.
    f. Adeka Ultra Seal: OCM Inc.
    g. Superstop: Tremco Construction Products Group

D. Joint Filler: Non-extruding, resilient asphalt impregnated fiberboard, cork or flexible foam, complying with ASTM D 1751, thickness as indicated on drawings and full depth of slab less ½ inch; tongue and groove profile.

E. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with minimum1 inch diameter holes for conduit or rebars to pass through at 6 inches on center, ribbed steel stakes for setting.

1. Provide removable plastic cap strip that forms wedge-shaped joint for sealant installation.
2. Height: To suit slab thickness.

F. Sealant and Primer: As specified in Section 07 90 05.

2.7 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.

1. Replace no less than 30% and no more than 50% of Portland cement in structural concrete with approved pozzolanic materials.
2. Ground Granulated Blast Furnace Slag Content: Not to exceed 50% of cementitious material by weight.
3. Fly Ash or Calcined Pozzolan Content: Not to exceed 25% of cementitious material by weight.
4. Silica Fume Content: Not to exceed 10% of total cementitious material by weight.
5. Obtain approval in advance before submitting mix containing any other pozzolanic substances.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.

1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.

D. Normal Weight Concrete:

1. Compressive Strength, when tested in accordance with ASTM C 39/C 39M at 28 days: As indicated on drawings.
2. Water-Cementitious Materials Ratio: Maximum 58% by weight. Maximum 40% by weight for exterior concrete.

a. Interior slabs shall have a maximum water-cementitious material ratio of 50% by weight.

3. Entrained air content for trowel-finished interior slabs shall not exceed 3%, determined in accordance with ASTM C 173/C 173M.
4. Entrained air content for footings shall not exceed 4.5%, determined in accordance with ASTM C 173/C 173M
5. Air Content for Exterior Exposed Concrete: Add air entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows with a tolerance of plus 1 or minus 1.5%, unless otherwise indicated.

   a. Air Content: 6% entrained air, determined in accordance with ASTM C 173/C 173M.

6. Maximum Slump: 4 inches.
7. Maximum Aggregate Size: 1 inch.

2.8 MIXING

A. Transit Mixers: Comply with ASTM C 94/C 94M.

B. Do not add water to concrete during delivery, at the project site or during placement except as predetermined by concrete mix, unless approved by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.2 PREPARATION

A. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning with steel brush and applying bonding agent, as indicated on the drawings, in accordance with the manufacturer's instructions.

B. Where new concrete with integral waterproofing is to be bonded to previously placed concrete, prepare surfaces to be treated in accordance with waterproofing manufacturer's instructions. Saturate cold joint surface with clean water, and remove excess water before application of coat of waterproofing admixture slurry. Apply slurry coat uniformly with semi-stiff bristle brush at rate recommended by waterproofing manufacturer.

C. In locations where new concrete is doweled to existing work, drill holes in existing concrete and insert steel dowels using an epoxy adhesive approved by the Architect.

D. Install vapor retarder under interior slabs on grade in accordance with manufacturer's instructions and ASTM E 1643.

1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.

2. Extend vapor barrier to the foundation wall and turn up vertically to terminate at the top of the slab. Vapor barrier shall be installed behind the isolation joint material and sealed to the masonry or concrete. Where obstructed by impediments, such as dowels, seal penetrations using manufacturer's textured seal tape per manufacturer's instructions. Ensure the concrete or masonry substrate is clean and dry prior to adhering tape.
3. Overlap joints 6 inches and seal with manufacturer's seam tape.
4. Apply seam tape to a clean and dry vapor barrier.
5. Seal all penetrations (including pipes) per manufacturer's instructions.
6. Avoid the use of non-permanent stakes driven through vapor barrier.
7. If non-permanent stakes are driven through vapor barrier, repair as recommended by vapor barrier manufacturer.
8. Repair damaged areas with vapor barrier material of similar (or better) permeance, puncture and tensile.

3.3 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Place concrete for floor slabs in accordance with ACI 302.1R.

C. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

D. Separate slabs on grade from vertical surfaces with joint filler.

E. Place joint filler in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

F. Extend joint filler from bottom of slab to within ½ inch of finished slab surface. Conform to Section 07 90 05 for finish joint sealer requirements.

G. Install joint devices in accordance with manufacturer's instructions.

H. Install construction joint devices in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

I. Install joint device anchors for expansion joint assemblies specified in Section 07 95 13. Maintain correct position to allow joint cover to be flush with floor and wall finish.

J. Apply sealants in joint devices in accordance with Section 07 90 05.

K. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

L. Place concrete continuously between predetermined expansion, control and construction joints.

M. Do not interrupt successive placement. Do not permit cold joints to occur.

N. Place slabs on grade with saw cut pattern indicated.

O. Saw cut joints as soon as the concrete is firm enough not to be damaged by the cutting action. Use 3/16 inch thick blade, cut into ¼ depth of slab thickness.

3.4 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas ¼ inch or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas ¼ inch or more in height. Provide finish as follows:

1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.

D. Concrete Slabs: Finish to requirements of Section 03 35 13.

3.5 CURING AND PROTECTION

A. Comply with requirements of Section 03 39 00.

3.6 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Division 1. Inspection services shall conform to Section 1705.3 and Table 1705.3 of the 2021 IBC Code and the Statement of Special Inspections noted in the structural drawings. The exceptions noted in Section 1705.3 shall not be allowed.

B. Provide free access to concrete operations at project site and cooperate with appointed firm; inspection to occur for:

1. Steel reinforcement placement.
2. Anchor bolts and studs.
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.
6. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.

E. Test composite samples of fresh concrete obtained according to ASTM C 172.

F. Compressive Strength Tests: ASTM C 39/C 39M.

1. Compression Test Specimens: ASTM C31/C 31M; cast and laboratory cure five 6”x12” standard cylinder specimens or seven 4”x8” standard cylinder specimens for each composite sample.
2. Test one laboratory-cured specimen at 7 days and one set of two 6”x12” or three 4”x8” specimens at 28 days. Remaining cylinders shall be held in reserve.

3. Obtain test samples for every 75 cu.yd. or less of each class of concrete placed each day.
4. A compressive-strength test shall be the average compressive strength from all specimens obtained from same composite sample and tested at age indicated.
5. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

G. Perform one slump test, at point of discharge for each set of test cylinders taken, following procedures of ASTM C 143/C 143M.

H. Perform air content test for each set of test cylinders taken, following procedures of ASTM C 231.

I. Perform unit weight test of structural lightweight concrete for each set of test cylinders taken, following procedures of ASTM C 567.

J. Test concrete temperature each hour when air temperature is 40 degrees F and below and when 80 degrees F and above, and for each set of test cylinders taken, following procedures of ASTM C 1064/C 1064M.

3.7 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to the Architect and Contractor within 24 hours of test.

1. Testing and inspecting agency will make additional tests of concrete when test results indicate that slump, compressive strengths, or other requirements have not been met, as directed by the Architect.
2. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by the Architect.
3. Additional testing and inspecting, at Contractor’s expense, will be performed to determine compliance of replaced or additional work with specified requirements.
4. Correct deficiencies that test reports and inspections indicate do not comply with specified requirements.

B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements. Repair or replace defective concrete, subject to the approval of the Architect.

C. Do not patch, fill, touch-up, repair or replace exposed concrete except upon express direction of the Architect for each individual area.

END OF SECTION 03 30 00

SECTION 03 35 13 - HIGH-TOLERANCE CONCRETE FLOOR FINISHING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Finishing slabs on grade and monolithic floor slabs.

B. Surface treatment with concrete hardener and sealer.

1.2 REFERENCE STANDARDS

A. ACI 301 – Specifications for Structural Concrete for Buildings; American Concrete Institute.

B. ACI 302.1R – Guide for Concrete Floor and Slab Construction; American Concrete Institute.

C. ASTM E 1155 – Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness.

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures.

B. Product Data: Provide data on concrete hardener and sealer, including information on compatibility of different products and limitations.

C. Submit floor surface flatness and levelness measurements to determine compliance with specified tolerances.

D. Maintenance Data: Provide data on maintenance renewal of applied coatings.

E. LEED Submittals: Comply with Section 01 81 13.

1. MR Credit 4: Material Ingredients.

a. Report: Concrete curing compounds, densifiers and sealers.

1.4 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301.

1. Maintain one copy on project site.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer’s sealed packaging, including application instructions.

1.6 PROJECT CONDITIONS

A. Coordinate the work with concrete floor placement and concrete floor curing.

1.7 FIELD CONDITIONS

A. Maintain ambient temperature of 50 degrees F minimum.

B. Provide ventilation sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.

PART 2 - PRODUCTS

2.1 COMPOUNDS – HARDENERS AND SEALERS

A. Chemical Hardener: Clear, chemically reactive, waterborne solution of inorganic siliconate materials and proprietary components, odorless, colorless, that penetrates, hardens, and densifies concrete surfaces.

1. Provide for exterior slabs and interior slabs not receiving a subsequent finish; regardless of Finish Schedule indicating concrete hardener or not.
2. VOC Content: Not to exceed 200 g/L.
3. Acceptable Products:

a. Ashford Formula, Concrete Chemical Company, Inc.
b. Seal Hard, L & M Concrete Chemicals, Inc.
c. Euco Diamond Hard, Euclid Chemical Company.

PART 3 - EXECUTION

3.1 FLOOR FINISHING

A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.1R.

B. Steel trowel surfaces that will receive carpeting, resilient floors, seamless flooring, thin set terrazzo or thin set ceramic tile.

C. Steel trowel surfaces that are scheduled to be exposed.

D. Fine-broomed finish for exterior slabs.

3.2 FLOOR SURFACE TREATMENT

A. Apply hardener to floor surfaces in accordance with manufacturer’s instructions.

3.3 TOLERANCES

A. An independent testing agency, as specified in Division 1, will inspect finished slabs for flatness.

B. Measure for F(F) and F(L) tolerances for floors in accordance with ASTM E 1155, within 48 hours after slab installation.

C. Finish concrete to achieve the following tolerances:

1. Slabs to be Covered with Thin Floor Coverings (i.e., resilient flooring). Specified overall values of flatness F(F) 35 and of levelness F(L) 25; with minimum local values of flatness, F(F) 24 and of levelness F(L) 17.
2. Slabs to be Covered with Carpet and Other Slabs: Specified overall values of flatness F(F) 25 and of levelness F(L) 20; with minimum local values of flatness, F(F) 17 and of levelness F(L) 15.
3. The F(L) values listed above are not applicable to elevated slabs on deck. Only F(F) values apply to elevated slabs.

D. Correct the slab surface if tolerances are less than specified.

E. Correct defects by grinding or by removal and replacement of defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

END OF SECTION 03 35 13

SECTION 03 39 00 - CONCRETE CURING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Initial and final curing of horizontal and vertical concrete surfaces.

1.2 REFERENCE STANDARDS

A. ACI 301 – Specifications for Structural Concrete for Buildings; American Concrete Institute.

B. ACI 302.1R – Guide for Concrete Floor and Slab Construction; American Concrete Institute.

C. ACI 305R – Hot Weather Concreting; American Concrete Institute.

D. ACI 306R – Cold Weather Concreting; American Concrete Institute.

E. ACI 308R – Guide to Curing Concrete; American Concrete Institute.

F. ASTM C 171 – Standard Specification for Sheet Materials for Curing Concrete.

G. ASTM C 309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

H. ASTM D 2103 – Standard Specification for Polyethylene Film and Sheeting.

1.3 SUBMITTALS

A. See Section 01 33 00 – Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on curing compounds, moisture-retaining sheet, and polyethylene film, including compatibility of different products and limitations.

C. LEED Submittals: Comply with Section 01 81 13.

1. MR Credit 4: Material Ingredients.

a. Report: Concrete curing compounds, densifiers and sealers.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301 and ACI 302.1R.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Membrane Curing Compound: ASTM C 309 Type 1 – Clear or translucent, Class B.

1. VOC Content not to exceed 350 g/L.

C. Moisture-Retaining Sheet: ASTM C 171.

1. Curing paper, regular.
2. Polyethylene film, clear, minimum nominal thickness of 0.0040 in.
3. White-burlap-polyethylene sheet, weighing not less than 10 oz/per linear yd., 40 inches wide.

D. Polyethylene Film: ASTM D 2103, 4 mil thick, clear.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are ready to be cured.

3.2 EXECUTION – HORIZONTAL SURFACES

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306R for cold-weather protection and ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb./sq. ft./h before and during finishing operations. Apply according to manufacturer’s written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Cure floor surfaces in accordance with ACI 308.

D. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges; maintain in place for not less than 4 days.

E. Absorptive Moisture-Retaining Sheet: Saturate burlap-polyethylene and place burlap side down over floor slab areas, lapping ends and sides; maintain in place for 7 days.

F. Membrane Curing Compound: Apply curing compound in accordance with manufacturer’s instructions in one coat.

3.3 EXECUTION – VERTICAL SURFACES

A. Cure surfaces in accordance with ACI 308.

B. Membrane Curing Compound: Apply compound in accordance with manufacturer’s instructions in one coat.

3.4 PROTECTION

A. Do not permit traffic over unprotected floor surface.

END OF SECTION 03 39 00

SECTION 03 45 00 – PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Architectural wet precast concrete for precast veneer walls
2. Architectural wet precast concrete for precast veneer monumental sign wall
3. Architectural wet precast concrete for wall caps
4. Architectural wet precast concrete for stairs
5. Architectural wet precast concrete windowsills (Murphy & Dittenhafer Architects' Scope)

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing connection anchors in concrete.
2. Section 055000 "Metal Fabrications" for kickers and other miscellaneous steel shapes.

1.2 DEFINITIONS

A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, preapproved by Architect.

1.3 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each wet precast concrete mixture. Include compressive strength and water-absorption tests.

C. Shop Drawings:

1. Detail fabrication and installation of architectural precast concrete units.
2. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit.

3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
4. Indicate details at building corners.
5. Indicate separate face and backup mixture locations and thicknesses.
6. Indicate type, size, and length of welded connections by AWS standard symbols. Detail loose and cast-in hardware and connections.
7. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
8. Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.
9. Include plans and elevations showing unit location and sequence of erection for special conditions.
10. Indicate location of each architectural precast concrete unit by same identification mark placed on panel.
11. Indicate relationship of architectural precast concrete units to adjacent materials.
12. Indicate locations, dimensions, and details of thin-brick units, including corner units and special shapes, and joint treatment.
13. Indicate locations, dimensions, and details of stone facings, anchors, and joint widths.
14. If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.

D. Samples: Design reference samples for initial verification of design intent, for each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of three, representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.

1. When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.
2. Samples for each thin-brick unit required, showing full range of color and texture expected. Include Sample showing color and texture of joint treatment.

a. Grout Samples for Initial Selection: Color charts consisting of actual sections of grout showing manufacturer's full range of colors.
b. Grout Samples for Verification: Showing color and texture of joint treatment to match precast concrete color.

E. Delegated-Design Submittal: For architectural precast concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Show governing panel types, connections, types of reinforcement, including special reinforcement, and concrete cover on reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from architectural precast concrete.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Material Certificates: For the following items:

1. Cementitious materials.

2. Reinforcing materials and pre-stressing tendons.
3. Admixtures.

C. Material Test Reports: For aggregates.

D. Preconstruction test reports.

E. Source quality-control test reports.

F. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance to erect Category A (Architectural Systems) for non-load-bearing members.

B. Installer Qualifications: A precast concrete erector who has retained a "PCI-Certified Field Auditor" to conduct a field audit of a project in same category as this Project and who can produce an Erectors' Post-Audit Declaration.

C. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1. Designated as a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units at time of bidding or designated as an APA-certified plant for production of architectural precast concrete products.

D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

E. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."

F. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D.1.1M, "Structural Welding Code - Steel"; and AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

G. Sample Panels: After sample approval and before fabricating architectural precast concrete units, produce a minimum of two sample panels approximately 16 sq. ft. in area for review by Architect. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.

1. Locate panels where indicated or, if not indicated, as directed by Architect.
2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
3. After acceptance of repair technique, maintain one sample panel at manufacturer's plant and one at Project site in an undisturbed condition as a standard for judging the completed Work.

4. Demolish and remove sample panels when directed.

H. Range Samples: After sample panel approval and before fabricating architectural precast concrete units, produce a minimum of three sets of samples, approximately 16 sq. ft. in area, representing anticipated range of each color and texture on Project's units. Maintain one set of range samples at Project site and remaining range sample sets at manufacturer's plant as color and texture approval reference.

I. Mockups: After sample panel and range sample approval but before production of architectural precast concrete units, construct full-sized mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockup as indicated on Drawings including and architectural precast concrete complete with anchors, connections, flashings, and joint fillers.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.

1.7 COORDINATION

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground or other re-handling.

B. Support units during shipment on non-staining shock-absorbing material.

C. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.

D. Place stored units so identification marks are clearly visible, and units can be inspected.

E. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.

F. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Southside Precast Products, 716-825-9300

Or

Arban Precast, 703-221-8005

B. Color: Contractor to provide 3 precast samples in shades of grey.

C. Finish: Medium acid etched finish

D. Size: Refer to contract documents for size

E. Provide reinforcement as required.

1. Walls – see contract drawings for dimensions.

2. Monumental Sign Wall – see architect's contract drawings for dimensions. Provide embossed/cast lettering in monumental wall referenced in 3/L4.03 & 5/A610 and in Specification 10 14 00 INTERIOR AND EXTERIOR SIGNAGE as TYPE 18. Shop drawings are to coordinate width of the panels, joints, and the spacing of the lettering so that joints fall between lettering. Submit shop drawings to Architect.

3. Wall Caps – see contract drawings for dimensions.

4. Stairs - see contract drawings for dimensions.

5. Windowsills (Murphy & Dittenhafer Architects' Scope):

a. Provide per the construction drawings for windowsills (see architect's contract drawings). Coordinate joints in shop drawings. Provide cast miter return with butt joint. Do not provide mitered joints.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design architectural precast concrete units.

B. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Pre-stressed Concrete," applicable to types of architectural precast concrete units indicated.

C. Calculated Fire-Test-Response Characteristics: Provide architectural precast concrete units with fire-resistance rating indicated as calculated according to PCI MNL 124, "Design for Fire Resistance of Precast Pre-stressed Concrete," and acceptable to authorities having jurisdiction.

D. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:

1. Loads: As indicated.
2. Dead Loads: Structures – Actual weight.

3. Live Loads: Contractor to provide structural engineer input to determine live loads for stair treads.
4. Wind Loads: Basic Wind speed (90MPH) or as required by applicable building code or ASCE/SEI 7, including basic wind speed, importance factor, exposure category, and pressure coefficient.
5. Seismic Loads: Refer to local codes.
6. Design precast concrete units and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements as follows:

    a. Upward and downward movement of 1/2 inch.

7. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 120 deg F.
8. Fire-Resistance Rating: Select material and minimum thicknesses to provide 2-hour fire rating or as required by local codes.
9. Contractor to verify that loads meet local codes and project site conditions.

2.3 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

B. Form Liners: Units of face design, texture, arrangement, and configuration to match those used for precast concrete design reference sample. Use with manufacturer's recommended form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

C. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

2.4 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

C. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.5 PRESTRESSING TENDONS

A. Pre-stressing Strand: ASTM A 416/A 416M, Grade 270, uncoated, seven-wire, low-relaxation strand.

1. Coat un-bonded post-tensioning strand with post-tensioning coating complying with ACI 423.7 and sheath with polypropylene tendon sheathing complying with ACI 423.7. Include anchorage devices and coupler assemblies.

2.6 CONCRETE MATERIALS

A. Portland cement: ASTM C 150/C 150M, Type I or Type III, white, unless otherwise indicated.

1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.

B. Supplementary Cementitious Materials:
1. Metakaolin: ASTM C 618, Class N.

C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33/C 33M, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.

a. Gradation: To match design reference sample.

2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand compatible with coarse aggregate; to match approved finish sample.

D. Lightweight Aggregates: Except as modified by PCI MNL 117, ASTM C 330/C 330M, with absorption less than 11 percent.

E. Coloring Admixture: ASTM C 979/C 979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.

Color to be selected by architect. To match color index 131- sandblasted medium

F. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

G. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

H. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.

7. Plasticizing Admixture: ASTM C 1017/C 1017M, Type I.
8. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
9. Corrosion Inhibiting Admixture: ASTM C 1582/C 1582M.

2.7 STAINLESS-STEEL CONNECTION MATERIALS

A. Stainless-Steel Plate: ASTM A 666, Type 304, Type 316, or Type 201.

B. Stainless-Steel Bolts and Studs: ASTM F 593, Alloy Group 1 or 2 hex-head bolts and studs; ASTM F 594, Alloy Group 1 or 2 stainless-steel nuts; and flat, stainless-steel washers.

1. Lubricate threaded parts of stainless-steel bolts with an anti-seize thread lubricant during assembly.

C. Stainless-Steel-Headed Studs: ASTM A 276, Alloy 304 or Alloy 316, with minimum mechanical properties of PCI MNL 117, Table 3.2.3.

2.8 ACCESSORIES

A. Reglets: Specified in Section 076200 "Sheet Metal Flashing and Trim."

B. Reglets: Stainless steel, Type 302 or Type 304, felt or fiber filled, or with face opening of slots covered.

C. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install architectural precast concrete units.

2.9 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C 150/C 150M, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.

B. Nonmetallic, Non-shrink Grout: Packaged, nonmetallic, noncorrosive, non-staining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, Grade A for dry-pack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.

C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881/C 881M, of type, grade, and class to suit requirements.

2.10 CONCRETE MIXTURES

A. Prepare design mixtures for each type of wet precast concrete required.

1. Use a single design mixture for units with more than one major face or edge exposed.
2. Where only one face of unit is exposed use either a single design mixture or separate mixtures for face and backup.

B. Limit use of fly ash and ground granulated blast-furnace slag to 20 percent of Portland cement by weight; limit metakaolin and silica fume to 10 percent of Portland cement by weight.

C. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.

D. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.

E. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures or full-depth mixtures, at fabricator's option by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi minimum.
2. Maximum Water-Cementitious Materials Ratio: 0.45.

F. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to ASTM C 642, except for boiling requirement.

G. Lightweight Concrete Backup Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.2, with materials to be used on Project, to provide lightweight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi.
2. Unit Weight: Calculated equilibrium unit weight of 115 lb/cu. ft., plus or minus 3 lb/cu. ft., according to ASTM C 567.

H. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

I. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.11 MOLD FABRICATION

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for pre-stressing and de-tensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and pre-stressing tendons by release agent.

1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.

B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

1. Form joints are not permitted on faces exposed to view in the finished work.
2. Edge and Corner Treatment: Uniformly radiused.

2.12 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.

D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or pre-stressing strand without Architect's approval.

E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
3. Place reinforcing steel and pre-stressing strands to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
4. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

F. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses and specified in-place loads.

G. Pre-stress tendons for architectural precast concrete units by either pre-tensioning or post-tensioning methods. Comply with PCI MNL 117.

1. Delay de-tensioning or post-tensioning of precast, pre-stressed architectural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete unit.
2. De-tension pre-tensioned tendons either by gradually releasing tensioning jacks or by heat-cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
3. If concrete has been heat cured, de-tension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.

H. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

I. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.

J. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.

1. Place backup concrete mixture to ensure bond with face-mixture concrete.

K. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.

1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Pre-stressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.

L. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.

M. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that does not show in finished structure.

N. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

O. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

2.13 FABRICATION TOLERANCES

A. Fabricate architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

B. Fabricate architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with the following product tolerances:

1. Overall Height and Width of Units, Measured at the Face Exposed to View: As follows:

    a. 10 feet or under, plus or minus 1/8 inch.
    b. 10 to 20 feet, plus 1/8 inch, minus 3/16 inch.
    c. 20 to 40 feet, plus or minus 1/4 inch.
    d. Each additional 10 feet, plus or minus 1/16 inch.

2. Overall Height and Width of Units, Measured at the Face Not Exposed to View: As follows:

    a. 10 feet or under, plus or minus 1/4 inch.
    b. 10 to 20 feet, plus 1/4 inch, minus 3/8 inch.
    c. 20 to 40 feet, plus or minus 3/8 inch.
    d. Each additional 10 feet, plus or minus 1/8 inch.

3. Total Thickness or Flange Thickness: Plus 1/4 inch, minus 1/8 inch.
4. Rib Thickness: Plus or minus 1/8 inch.
5. Rib to Edge of Flange: Plus or minus 1/8 inch.
6. Distance between Ribs: Plus or minus 1/8 inch.
7. Variation from Square or Designated Skew (Difference in Length of the Two Diagonal Measurements): Plus or minus 1/8 inch/72 inches or 1/2 inch total, whichever is greater.
8. Length and Width of Block-outs and Openings within One Unit: Plus or minus 1/4 inch.
9. Location and Dimension of Block-outs Hidden from View and Used for HVAC and Utility Penetrations: Plus or minus 3/4 inch.
10. Dimensions of Haunches: Plus or minus 1/4 inch.
11. Haunch Bearing Surface Deviation from Specified Plane: Plus or minus 1/8 inch.
12. Difference in Relative Position of Adjacent Haunch Bearing Surfaces from Specified Relative Position: Plus or minus 1/4 inch.
13. Bowing: Plus or minus L/360, maximum 1 inch.
14. Local Smoothness: 1/4 inch/10 feet.
15. Warping: 1/16 inch/12 inches of distance from nearest adjacent corner.
16. Tipping and Flushness of Plates: Plus or minus 1/4 inch.
17. Dimensions of Architectural Features and Rustications: Plus or minus 1/8 inch.

C. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.

1. Weld Plates: Plus or minus 1 inch.
2. Inserts: Plus or minus 1/2 inch.
3. Handling Devices: Plus or minus 3 inches.
4. Reinforcing Steel and Welded Wire Reinforcement: Plus or minus 1/4 inch where position has structural implications or affects concrete cover; otherwise, plus or minus 1/2 inch.
5. Reinforcing Steel Extending out of Member: Plus or minus 1/2 inch of plan dimensions.
6. Tendons: Plus or minus 1/4 inch, vertical; plus or minus 1 inch, horizontal.

7. Location of Rustication Joints: Plus or minus 1/8 inch.
8. Location of Opening within Panel: Plus or minus 1/4 inch.
9. Location of Flashing Reglets: Plus or minus 1/4 inch.
10. Location of Flashing Reglets at Edge of Panel: Plus or minus 1/8 inch.
11. Reglets for Glazing Gaskets: Plus or minus 1/8 inch.
12. Electrical Outlets, Hose Bibs: Plus or minus 1/2 inch.
13. Location of Bearing Surface from End of Member: Plus or minus 1/4 inch.
14. Allowable Rotation of Plate, Channel Inserts, and Electrical Boxes: 2-degree rotation or 1/4 inch maximum over the full dimension of unit.
15. Position of Sleeve: Plus or minus 1/2 inch.
16. Location of Window Washer Track or Buttons: Plus or minus 1/8 inch.

2.14 FINISHES

A. Exposed faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved sample panels /mockups and as follows:
   1. PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers indicated.
   2. As-Cast Surface Finish: Provide surfaces to match approved sample for acceptable surface, air voids, sand streaks, and honeycomb.
   3. Textured-Surface Finish: Impart by form liners or inserts.
   4. Exposed-Aggregate Finish: Use chemical retarding agents applied to concrete forms and washing and brushing procedures to expose aggregate and surrounding matrix surfaces after form removal.
   5. Polished Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.

B. Finish exposed top surfaces of architectural precast concrete units to match face-surface finish.

C. Finish unexposed surfaces of architectural precast concrete units by float finish.

2.15 SOURCE QUALITY CONTROL

A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, ASTM C 1610/C 1610M, ASTM C 1611/C 1611M, ASTM C 1621/C 1621M, and ASTM C 1712.

B. Contractor will employ an independent, third-party testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.

   1. Cooperate with testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.

C. Strength of precast concrete units is considered deficient if units fail to comply with ACI 318 (ACI 318M) requirements for concrete strength.

D. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 (ACI 318M) requirements, precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M and ACI 318 (ACI 318M).

1. A minimum of three representative cores shall be taken from units of suspect strength, from locations directed by Architect.
2. Test cores in an air-dry condition.
3. Strength of concrete for each series of three cores is considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
4. Report test results in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports include the following:

    a. Project identification name and number.
    b. Date when tests were performed.
    c. Name of precast concrete fabricator.
    d. Name of concrete testing agency.
    e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

E. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

F. Defective Units: Discard and replace recast architectural concrete units that do not comply with acceptability requirements in PCI MNL 117, including concrete strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Architect's approval. Architect reserves the right to reject precast units that do not match approved samples, sample panels, and mockups. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.

B. Do not install precast concrete units until supporting cast-in-place concrete has attained minimum allowable design compressive strength and supporting steel or other structure is structurally ready to receive loads from precast concrete units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.

1. Install temporary steel or plastic spacing shims as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
4. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch.

C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

1. Do not permit connections to disrupt continuity of roof flashing.

D. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

1. Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
2. Welds not specified shall be continuous fillet welds, using no less than the minimum fillet as specified by AWS.
3. Clean weld-affected metal surfaces with chipping hammer followed by brushing and apply a minimum 4.0-mil- thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780/A 780M.
4. Clean weld-affected metal surfaces with chipping hammer followed by brushing and reprime damaged painted surfaces.
5. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.

E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.

2. For slip-critical connections, use one of the following methods to assure proper bolt pretension:

    a. Turn-of-Nut: According to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
    b. Calibrated Wrench: According to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
    c. Twist-off Tension Control Bolt: ASTM F 1852.
    d. Direct-Tension Control Bolt: ASTM F 1852.

3. For slip-critical connections, use method and inspection procedure approved by Architect and coordinated with inspection agency.

F. Grouting or Dry-Packing Connections and Joints: Grout connections where required or indicated. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for not less than 24 hours after initial set.

3.3 ERECTION TOLERANCES

A. Erect architectural precast concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

B. Erect architectural precast concrete units level, plumb, square, and in alignment, without exceeding the following noncumulative erection tolerances:

1. Plan Location from Building Grid Datum: Plus or minus 1/2 inch
2. Plan Location from Centerline of Steel: Plus or minus 1/2 inch
3. Top Elevation from Nominal Top Elevation: As follows:

    a. Exposed Individual Panel: Plus or minus 1/4 inch
    b. Non-Exposed Individual Panel: Plus or minus 1/2 inch
    c. Exposed Panel Relative to Adjacent Panel: 1/4 inch
    d. Non-Exposed Panel Relative to Adjacent Panel: 1/2 inch

4. Support Elevation from Nominal Support Elevation: As follows:

    a. Maximum Low: 1/2 inch
    b. Maximum High: 1/4 inch

5. Maximum Plumb Variation over the Lesser of Height of Structure or 100 Feet : 1 inch
6. Plumb in Any 10 Feet of Element Height: 1/4 inch
7. Maximum Jog in Alignment of Matching Edges: 1/4 inch
8. Joint Width (Governs over Joint Taper): Plus or minus 1/4 inch
9. Maximum Joint Taper: 3/8 inch
10. Joint Taper in 10 Feet: 1/4 inch
11. Maximum Jog in Alignment of Matching Faces: 1/4 inch
12. Differential Bowing or Camber, as Erected, between Adjacent Members of Same Design: 1/4 inch

13. Opening Height between Spandrels: Plus or minus 1/4 inch

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Visually inspect field welds and test according to ASTM E 165 or to ASTM E 709 and ASTM E 1444. High-strength bolted connections are subject to inspections.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS

A. Repair architectural precast concrete units if permitted by Architect. Architect reserves the right to reject repaired units that do not comply with requirements.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet .

C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780/A 780M.

D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.6 CLEANING

A. Clean surfaces of precast concrete units exposed to view.

B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect other work from staining or damage due to cleaning operations.

2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 03 45 00

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units (CMU).
2. Concrete Block Veneer.
3. Mortar and grout materials.
4. Reinforcement.
5. Ties and anchors.
6. Embedded flashing.
7. Accessories.
8. Lintels

B. Products Installed but not Furnished under This Section:

1. Steel lintels in unit masonry.
2. Steel shelf angles for supporting unit masonry.
3. Cavity wall insulation.
4. Thru-wall metal flashing.

C. Related Sections:

1. Division 01 Section "Mockups" for integrated exterior mockup requirements.
2. Division 04 Section Cast Stone Masonry for cast stone window sills
3. Division 05 Section "Metal Fabrications" for furnishing steel lintels and shelf angles for unit masonry.
4. Division 07 Section "Sheet Metal Flashing and Trim" for thru-wall metal flashing and reglets installed in masonry.
5. Division 07 Section "Air Barriers" for fluid-applied, vapor permeable water resistive air barrier and through wall flashing.
6. Division 07 Section "Thermal Insulation" for cavity wall insulation.

1.3 REFERENCE STANDARDS

A. TMS 402 – Building Code Requirements for Masonry Structures; The Masonry Society.

B. TMS 602 – Specification for Masonry Structures; The Masonry Society.

C. ASTM A 82/A 82M – Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

D. ASTM A 153/A 153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

E. ASTM A 615/A 615M – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

F. ASTM A 641/A 641M – Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.

G. ASTM C 67 – Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.

H. ASTM C 90 – Standard Specification for Loadbearing Concrete Masonry Units.

I. ASTM C 140 – Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units.

J. ASTM C 144 – Standard Specification for Aggregate for Masonry Mortar.

K. ASTM C 150 – Standard Specification for Portland Cement.

L. ASTM C 207 – Standard Specification for Hydrated Lime for Masonry Purposes.

M. ASTM C 216 – Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).

N. ASTM C 270 – Standard Specification for Mortar for Unit Masonry.

O. ASTM C 404 – Standard Specification for Aggregates for Masonry Grout.

P. ASTM C 476 – Standard Specification for Grout for Masonry.

Q. ASTM C 780 – Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

R. ASTM C 979 – Standard Specification for Pigments for Integrally Colored Concrete.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
4. Special Shapes: Details and installation methods incorporating special shape units.

5. Masonry Veneered Mockup coordinated with GC's Mockup Panel.

C. Samples for Initial Selection:

1. Colored mortar.

D. Samples for Verification: For each type and color of the following:

1. Concrete Block Veneer, full-size.
2. CMU, full-size.
3. Special block shapes, full-size.
4. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.
5. Weep/cavity vents in color to match mortar.
6. Cavity drainage material.
7. Accessories embedded in masonry.

1.6 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product indicated. For masonry units include data on material properties, material test reports substantiating compliance with requirements.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

C. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified in accordance with ASTM C1093 for testing indicated.

B. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 – level 3 unless modified by requirements in the Contract Documents.

C. Comply with provisions of TMS 402 and TMS 602, except where exceeded by requirements of the contract documents.

1. Maintain one copy of each document on project site.

D. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on each type of unit required per test method indicated.
1. Concrete Masonry Units: ASTM C 140.
2. Mortar: For properties per ASTM C 270.

E. Grout: For compressive strength per ASTM C 1019.

1.8 MOCKUPS

A. Include concrete block veneer in integrated exterior mockup that will be used to demonstrate aesthetic effects, perform preconstruction testing, and to set quality standards for materials and installation. See Division 01 Section "Mockups" for additional construction requirements. Provide shop drawing to be coordinated with mockup layout.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

1. Protect concrete masonry units from moisture absorption so that, at the time of installation, the moisture content is not more than the maximum allowed at the time of delivery.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe, and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.
2. When ambient temperature exceeds 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 - PRODUCTS

2.1 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

C. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows:

1. Provide

2. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
3. Provide bullnose units for all interior outside corners unless otherwise indicated.
4. Grout top round and smooth on interior CMU knee walls (see holding area bullpens)

B. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi for f'm=2000 psi.
2. Density Classification: Normal weight unless otherwise indicated.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.

2.3 ARCHITECTURAL CONCRETE MASONRY UNITS

A. Veneer Units: Provide unit types and sizes as follows:

1. Products: subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. York Building Products, 717-885-3190, www.yorkbuilding.com.
2. Masonry units meeting all ASTM C 90 testing requirements and containing integral mixed color.
3. Unit Weight: normal weight units.
4. Linear Shrinkage: not to exceed 0.065 percent, ASTM C 90.
5. Unit Compressive Strength: Minimum net area compressive strength of 2,000 psi.
6. Integral Water Repellent Units: all exterior wall architectural concrete masonry units, including single wythe walls and facing units shall be manufactured using the manufacturer's integral polymeric water-repellent admixture.
7. Mortar Joint: concave.
8. Size, color and type: as shown in the drawings and listed below.
   a. Light Field block: Gemstone, 4" x 8" x 16" nominal and 4" x 4" x 16" nominal, color to be selected by Architect from standard colors (base selection Kodiak).
   b. Warm Band block: Rustic Face, 4" x 8" x 16" nominal and 4" x 4" x 16" nominal, color to be selected by Architect from standard colors (base selection Camel).
   c. Dark Band block: Gemstone, 4" x 8" x 16" nominal and 4" x 4" x 16" nominal, color to be selected by Architect from standard colors (base selection Mink).
   d. Blue Accent block: Gemstone, 4" x 8" x 16" nominal and 4" x 4" x 16" nominal, custom color. Color matched to JANDRIS #2512
      1) https://ajandris.com/products/architectural-cmu/ground-face-cmu/colors/

2.4 LINTELS

A. Solid Concrete Masonry Lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength of not less than that of CMUs.

2.5 MORTAR AND GROUT MATERIALS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Colored Portland Cement-Lime Mix:

   a. Eaglebond; Blue Circle Cement.
   b. Color Mortar Blend; Glen-Gery Corporation.
   c. Rainbow Mortamix Custom Color Cement/Lime; Holnam, Inc.
   d. Centurion Colorbond PL; Lafarge Corporation.
   e. Lehigh Custom Color Portland/Lime; Lehigh Portland Cement Co.

f. Riverton Portland Cement Lime Custom Color; Riverton Corporation (The).

2. Mortar Pigments:

a. True Tone Mortar Colors; Davis Colors.
b. Centurion Pigments; Lafarge Corporation.
c. SGS Mortar Colors; Solomon Grind-Chem Services, Inc.

B. Portland Cement: ASTM C150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

C. Hydrated Lime: ASTM 207, Type S.

D. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C150, Type I or Type III, and hydrated lime complying with ASTM C207, Type S; containing no other ingredients.

E. Masonry Cement: ASTM C91.

F. Aggregate for Mortar: ASTM C144.

1. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color to match existing.

G. Aggregate for Grout: ASTM C404.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Euclid Chemical Company (The); Accelguard 80.
b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.

I. Water: Clean and potable.

2.6 REINFORCEMENT

A. Recycled Content: Provide steel with minimum 90 percent total recycled content, including at least 60 percent post-consumer recycled content.

B. Uncoated Steel Reinforcing Bars: ASTM A615/A615M, Grade 60.

C. Masonry Joint Reinforcement, General: ASTM A951/A951M.

1. Hot-dip galvanized, carbon steel wire for both interior and exterior walls.
2. Wire Size and Side Rods: W1.7 or 0.148 inch diameter (9 gauge) unless otherwise noted.

3. Wire Size and Cross Rods: W1.7 or 0.148 inch diameter (9 gauge) unless otherwise noted.
4. Wire Size for Veneer Ties: W2.8 or 0.1875 inch diameter (3/16 inch).
5. Spacing for Cross Rods: Not more than 16 inches on center.
6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

D. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods and cross rods spaced not more than 16 inches o.c. Truss type shall not be used in vertically reinforced unit masonry walls.

E. Masonry-Joint Reinforcement for Multiwythe Masonry:

1. Adjustable (2-piece) type with single pair of side rods and cross ties spaced not more than 16 inches o.c. and with separate adjustable veneer ties engaging the cross ties. Crossties are either U-shaped with eyes or rectangular. Space side rods for embedment within each face shell of backup wythe and size adjustable ties to extend at least halfway through outer wythe but with at least 5/8-inch cover on outside face. Unless otherwise indicated, install in first and second courses above finished floor and in alternating back-up masonry courses thereafter.

   a. Use where indicated and where horizontal joints of facing wythe do not align (1-1/4” or less) with those of backup wythe.
   b. Use where facing wythe is of different material than backup wythe.
   c. Provide “#270 Ladder Eye-Wire anchor system by Hohmann & Barnard, Inc., or equal product.

2. Adjustable (3-piece) type with ladder type reinforcement at back-up wythe which includes an extended cross rod. A vertical rod is hooked onto the extended cross rod and extends down to and behind the cross rod of the next lower truss type unit. An adjustable vee tie is hooked around the vertical rod for placement into the mortar joint of the face veneer.

   a. Use where indicated and where horizontal joints of facing wythe do not align (greater than 1-1/4”) with those of the back-up wythe.
   b. Provide “Tie-HVR” anchor system by Hohmann & Barnard, Inc., or equal product.

2.7 TIES AND ANCHORS

A. General: Ties and anchors extend at least halfway into veneer but with at least a 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches (50 mm) parallel to face of veneer.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M; with ASTM A153/A153M, Class B-2 coating.
2. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 zinc coating.
3. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
4. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.

1. Wire: Fabricate from 1/4-inch-diameter, hot-dip galvanized steel wire.

D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch-thick, steel sheet, galvanized after fabrication.
2. Tie Section: Triangular-shaped wire tie made from 0.25-inch-diameter, hot-dip galvanized steel wire.
3. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.25-inch-diameter, hot-dip galvanized steel wire.
4. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section with single hole for expansion bolt. Anchor to be installed before insulation installation.

a. Basis-of-Design Product: subject to compliance with requirements, provide 'HB-5213 Anchor' by Hohmann & Barnard or a comparable product by one of the following manufacturers, but not limited to

1) Wire-Bond
2) Heckmann Building Products

E. Partition Top anchors: 0.105-inch-thick metal plate with 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

F. Joint Stabilization Anchors

1. General: Provide stabilization anchors in horizontal joints of masonry units across the joint between walls at T-shape wall intersections as follows:

a. Use 1-1/2" x ¼" x 24" steel strap anchor with 3" (90 degree) right-angle bent ends at masonry shear walls.
b. Anchors to be embedded in grout-filled cores of hollow concrete masonry units.
c. 16" o.c. vertical spacing.
d. Finish: Mill galvanized or hot-dip galvanized to comply with ASTM A 153

G. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to metal studs, and as follows:

a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.

2. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.25-inch-diameter, hot-dip galvanized steel wire.
3. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section with screw holes top and bottom. Anchor to be installed before insulation installation.

a. Basis-of-Design Product: subject to compliance with requirements, provide 'HB-213 Anchor' by Hohmann & Barnard or a comparable product by one of the following manufacturers, but not limited to

1) Wire-Bond
2) Heckmann Building Products

b. Anchor Section: Gasketed sheet metal plate with screw holes top and bottom; top and bottom ends bent to form pronged legs to penetrate insulation/sheathing and contact studs; and raised rib-stiffened strap stamped into center to provide a slot between strap and plate for connection of wire tie.
c. Plate 1-1/4 inches wide by 6 inches long with strap 5/8 inch wide by 6 inches long; slot clearance formed between face of plate and back of strap shall not exceed diameter of wire tie by more than 1/32 inch.
d. Provide anchor manufacturer's standard, self-adhering, gaskets manufactured to fit behind anchor plate and to prevent moisture from penetrating sheathing at pronged legs and screw holes.

H. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M.

I. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A307, Grade A; with ASTM A563/A563M hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A153/A153M, Class C; of dimensions indicated.

2.8 EMBEDDED FLASHING

A. Refer to Division 07 Section "Sheet Metal Flashing and Trim".

2.9 ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

C. Cavity Weep/Vents: Use the following unless otherwise indicated:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
2. Basis-of-Design: 'CellVent' by Mortar Net Solutions.

D. Sill Weep: 100% virgin high impact polystyrene; 2-1/4" wide weep legs at 9-1/2" on center; continuous belt 1" (25.4mm) wide; and total width of 6". Sill weep to be installed on top face of flashing with continuous belt centered at masonry opening (i.e., window sill flashing conditions only). Fabric skirt to overlap continuous belt and run vertically up exterior face of flashing material.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity to avoid being clogged by mortar droppings, thickness to match cavity air space.

1. Rainscreen Drainage Mat: Sheets or strips not less than full depth of cavity thick and installed to full height of cavity, with additional strips 4 inches high at weep holes and thick enough to fill entire depth of cavity to prevent weep holes from clogging with mortar.
2. Basis-of-Design: 'MortarNet' by Mortar Net Solutions.

F. Proprietary Acidic Masonry Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.10 LINTELS

A. Concrete Lintels: Precast units made from concrete matching concrete masonry units in color, texture, and compressive strength and with reinforcing bars as required by the structural drawings. Cure precast lintels by same method used for concrete masonry units.

B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars as required by the structural drawings and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type M.
2. For above-grade walls, use Type S.
3. Exterior concrete block veneer veneer, use Type N.

D. Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required.

1. Pigments do not exceed 10 percent of portland cement by weight.
2. Pigments do not exceed 5 percent of mortar cement by weight.
3. Mix to match Architect's sample.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Mix to match Architect's sample.

F. Grout for Unit Masonry: Comply with ASTM C476.

1. Consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
2. Use grout confirming to ASTM C476 with a minimum 28-day compressive strength of 3000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 INSTALLATION, GENERAL

A. Unit Masonry Assemblies shall be installed in accordance with Contract Documents, most recent technical standards published by International Masonry Institute, National Concrete Masonry Association, Brick Industry Association and the product manufacturer’s printed recommendations.

B. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual widths of masonry units, using units of widths indicated.

C. Build chases and recesses to accommodate items specified in this Section and in other Sections of the Specifications.

D. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to the opening.

E. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

F. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

G. Wetting of Concrete block veneer: Wet concrete block veneer before laying if initial rate of absorption exceeds 20 g/30 sq. in. per minute when tested per ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

H. No conduit or pipe shall be installed vertically or horizontally in the cavity, except for items such as wall hydrants, electrical fixtures, etc., for which penetrations shall be horizontal, perpendicular through cavity, located directly at the intended item.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 7 Section “Fire-Resistive Joint Systems”.

3.4 TOLERANCES

A. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:

B. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.

C. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, nor 1/2 inch maximum.

D. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.

E. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.

F. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.

3.5 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed CMU Masonry: Unless otherwise indicated above, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Bond Pattern for Exposed Concrete block veneer Masonry: Unless otherwise indicated above, lay exposed masonry in Flemish bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet concrete block veneer if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between hollow-metal frames and masonry solidly with mortar unless otherwise indicated.

G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.6 MORTAR BEDDING AND JOINTING

A. Lay CMUs and concrete block veneer as follows:

1. Fully bed units in mortar and make head joints of depth equal to bed joints.
2. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
3. Fully bed units and fill cells with grout at anchors and ties as needed to fully embed anchors and ties in grout.

B. Lay solid masonry units and concrete block veneer with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.
3. Wet joint surfaces thoroughly before applying mortar.
4. Rake out mortar joints for pointing with sealant.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.7 MULTIWYTHE MASONRY

A. Bond wythes of composite masonry together as follows:

1. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.

a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties.

B. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.

1. Provide continuity with masonry-joint reinforcement at corners by using prefabricated L-shaped units as well as masonry bonding.

C. Intersecting and Abutting Walls: Unless vertical expansion or control joints are indicated at juncture, bond walls together as follows:

1. Provide continuity with masonry-joint reinforcement by using prefabricated T-shaped units.

3.8 CAVITY WALLS

A. Bond wythes of cavity walls together as follows:

1. Masonry Joint Reinforcement: Installed in horizontal mortar joints.

a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.9 MASONRY JOINT REINFORCEMENT

A. General: Provide continuous masonry joint reinforcement as indicated. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 16 inches beyond openings in addition to continuous reinforcement.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

C. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

D. Provide continuity at wall intersections by using prefabricated T-shaped units.

E. Provide continuity at corners by using prefabricated L-shaped units.

F. At all flashing locations, reinforcement shall not interrupt the flashing.

3.10 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in concrete block veneer as follows:

1. Form open joint full depth of concrete block veneer wythe and of width indicated; install compressible exterior expansion joint filler as per manufacturers' recommendation. Keep joint free and clear of mortar. Locations as indicated on drawings.

D. Provide horizontal, pressure-relieving joints by inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

E. Isolate masonry partitions from vertical structural framing members with a control joint.

F. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.11 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.

C. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

D. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.

3.12 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Support and secure reinforcing bars from displacement. Maintain position within ½ inch of dimensioned position.
3. Place and consolidate grout fill without displacing reinforcing.
4. At bearing locations, fill masonry cores with grout for a minimum of 12 inches either side of opening.

D. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at a maximum of 24 inches horizontally and 16 inches vertically.

1. Provide an open space not less than ½ inch in width between masonry and structural member, unless otherwise indicated.
2. Keep open space free of mortar and other rigid materials.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.

B. Inspections: An independent testing agency will perform field quality control tests, as specified in Division 1. Inspection services shall conform to Section 1705.4 of the 2018 IBC Code, Level B Quality Assurance Program of TMS 402 and TMS 602, and the Statement of Special Inspections noted in the structural drawings

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

D. Testing Frequency: Tests and Evaluations listed in this Article will be performed during construction for each 35,000 bricks or 5,700 concrete masonry units Testing requirements for mortar and grout may be deleted if prism testing is retained.

E. Concrete Masonry Unit Test: Test each variety of concrete unit masonry in accordance with ASTM C 140 for conformance to requirements of this specification.

F. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780.

G. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.

H. Weep Test: Allow masonry 12 hours setting time before test. Test to be done in 10’ lengths of cavity.

3.14 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
3. Protect surfaces from contact with cleaner.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete block veneer by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
7. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 04 20 00

SECTION 04 72 00 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. Section Includes:
   1. Cast Corner stone with graphics & lettering

B. Related Sections:
   1. Division 03 Section "Precast Architectural Concrete"
   2. Division 04 Section "Unit Masonry" for mortar mixes and flashing.
   3. Division 07 Section "Joint Sealants."
   4. Division 10 Section "Interior and Exterior Signage"

1.3 DEFINITIONS

A. Dry Cast Concrete Products are manufactured from zero-slump concrete.

   1. The Vibrant Dry Tamp (VDT) casting method: manufactured from earth-moist, zero-slump concrete using vibratory ramming against a rigid mold until it is densely compacted.
   2. The Machine Casting Method, manufactured from earth-moist, zero-slump concrete compacted by machinery using vibration and pressure against a rigid mold until it is densely compacted.

B. Wet Cast Concrete Products are manufactured from measurable-slump concrete.

   1. Wet casting method: Manufactured from measurable slump concrete and vibrated into a mold until it becomes densely consolidated.

C. Cast Stone is a refined architectural concrete building unit manufactured to simulate natural cut stone, used in unit masonry applications.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For cast stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. e profiles, cross sections, dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

1. Include building elevations showing layout of units and locations of joints and anchors.

C. Samples for Verification:

1. For each color and texture of cast stone required, 6 inches square in size.
2. For colored mortar.
3. Provide Sample for Corner stone sample of 12in x 12in cast stone demonstrating embossed graphic & lettering and for color confirmation.
4. Samples must be submitted in conjunction with samples for Division 4 Section “Unit masonry”.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Include list of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1. Include current plant certification from the Architectural Precast Association.

B. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C1364.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Sole source requirement: Company specializing in production of architectural precast concrete and architectural cast stone with minimum of ten (10) years documented experience.
2. Has sufficient production capacity to produce required units without delaying the Work.
3. Manufacturer is a certified producing member of the Architectural Precast Association.

B. Installer Qualifications:

1. Installer shall have sufficient resources to install the cast stone and architectural precast shown in the architectural drawings in accordance with the project schedule.
2. Installer shall have not less than three (3) years continuous operational experience in successful installation of cast stone and architectural precast in types and quantities similar to the project.

1.7 MOCKUPS

1. Provide full size product for approval to be considered mock-up for quality. Graphic and lettering must be legible and meet owners’ approval before accepting. Approved Mock up can be installed if approved.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the Work and to minimize the need for on-site storage.

B. All cast stone units shall be labeled on a non-exposed face with the identification mark shown in the manufacturer's shop drawings.

C. Pack, handle, and ship cast stone units in suitable packs or pallets.

1. An itemized list of products shall be provided for each shipment of cast stone units.
2. All pallets shall be labeled with a complete list of the pallet contents.
3. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units if required, using dollies with wood supports.
4. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

1.9 PROJECT CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements in TMS 602.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace architectural precast concrete units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of design: Design is based upon cast stone units produced by Nelson Precast Products. Provide specified products or comparable products by one of the following fabricators, but not limited to:
1. Nelson Precast Products
2. Sun Precast Co., Inc.
3. Cast Stone Designs, Inc.

B. Source Limitations: Obtain architectural precast and cast stone from a single manufacturer.

2.2 CAST CORNER STONE

1. Provide at embossed/cast lettering in cast stone corner stone referenced in 3/A610 and in Specification 10 14 00 INTERIOR AND EXTERIOR SIGNAGE as TYPE 19.
2. Architect to select color mix from manufacturers full color line.
3. Vector file of artwork/county seal to be provided by owner with assistance from architect.

2.3 MATERIALS, GENERAL

A. Regional Materials: Manufacture cast stone units within 100 miles (160 km) of Project site from aggregates that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles (160 km) of Project site.

B. Regional Materials: Manufacture aggregate for mortar and grout within 100 miles (160 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles (160 km) of Project site.

2.4 CAST STONE MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type III, white and/or grey, ASTM C 150

B. Coarse Aggregates: Granite, quartz, or limestone, ASTM C 33 (except for gradation). Coarse aggregates shall be optional for units made using the Vibrant Dry Tamp (VDT) casting method.

C. Fine Aggregates: Manufactured or natural sands, ASTM C33/C33M (except for gradation).

D. Colors: Inorganic iron oxide pigments, ASTM C979/C979M (except that carbon black pigments shall not be used).

E. Admixtures:

1. ASTM C260/C260M for air-entraining admixtures (not for use in Dry Cast Concrete Products)
2. ASTM C494/C495M Types A – G for water reducing, retarding, accelerating, and high range admixtures.
3. Other admixtures for which no ASTM standard exists, including integral water repellants and other chemicals, shall be previously established as suitable for use in concrete by proven field performance or through laboratory testing.

F. Water: Clean and potable municipal water.

G. Reinforcing:

1. ASTM A615/A615M for reinforcing bars using grade 40 or 60 steel. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of cast stone material.
2. ASTMA185 for welded wire fabric (not for use in Dry Cast Concrete Products)

H. All anchors, dowels, and other anchoring devices and shims shall be Type 304 stainless steel.

2.5 CAST STONE UNITS

A. Cast Stone Units: Comply with ASTM C1364.

B. Colors and Textures:

1. As selected by Architect from manufacturer's full range.

C. Physical properties:

1. Compressive strength shall meet or exceed 6,500 psi at 28 days when tested according to ASTM C 1194.
2. Absorption shall not exceed 6% when tested according to the cold water method described in ASTM C 1195.
3. Air content shall be between 4-8% for units produced by the Wet Cast method in accordance with Test Method C173/C173M or Test Method C231/C231M. Air entrainment is not required for units produced by the Vibrant Dry Tamp (VDT) casting method.
4. Freeze-thaw: ASTM C666/C666M in accordance with ASTM C1364. The CPWL shall be less than 5.0% after 300 cycles of freezing and thawing.
5. Linear Drying Shrinkage: ASTM C426: Test and report in accordance with ASTM C1364.

D. Manufacturer shall test units for conformance to compressive strength requirements at least once for every 500 cubic feet of material produced.

E. Job site testing may be performed in accordance with ASTM C1194 and C1195.

2.6 MANUFACTURING TOLERANCES

A. Color and Finish:

1. Cast Stone shall be appraised for color and finish quality under direct daylight illumination to avoid crosslighting conditions.
2. All surfaces exposed to view shall have a fine-grained texture similar to natural stone. Air voids shall not be obvious when viewed under direct daylight illumination at a 5 ft distance.
3. All units provided shall display a color and texture equal to the approved sample when viewed under direct daylight illumination at a 10 ft distance.
4. The range of total acceptable color (lightness, color saturation, and hue) variation shall not exceed a ΔE of 6.0 (CIELAB 1976) when measured per ASTM D 2244, provided that hue does not exceed a ΔE of 2.0.

B. Units:

1. All pieces shall be made exactly in accordance with approved shop drawings.
2. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
3. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
4. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.

5. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.

C. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.

1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
2. Provide drips on projecting elements unless otherwise indicated.

2.7 REINFORCING

A. Reinforcing to be provided where necessary to facilitate safe handling and setting or to withstand structural stresses.

B. Cast Stone panels, soffits, and similar stones greater than 24 inches in one direction shall be reinforced in that direction.

C. Cast Stone units less than 24 inches in both their length and width shall be non-reinforced unless otherwise specified.

2.8 CURING

A. Cure units in enclosed, moist curing room at 95 percent relative humidity and temperature of 90 deg F for 16 hours.

B. Keep units damp and continue curing to comply with one of the following:

1. No fewer than five days at mean daily temperature of 70 deg F or above.
2. No fewer than seven days at mean daily temperature of 50 deg F or above.

C. Form-cured units shall be protected from moisture evaporation with curing blankets or curing compounds after casting.

D. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

2.9 ACCESSORIES

A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666.

B. Dowels: 1/2-inch-diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666.

C. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cast stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.

2.10 MORTAR MIXES

A. Comply with requirements in Division 04 Section "Unit Masonry" for mortar mixes.

1. For setting mortar, use Type S.
2. For pointing mortar, use Type N.
3. Pigmented Mortar: Use colored cement product.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Inspect all cast stone units prior to accepting delivery and check all cast stone units for fit and finish prior to installation. Do not set unacceptable units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING TOLERANCES

A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

B. Variation from Level: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

C. Variation in Joint Width: Do not deviate from specified joint thickness more than 1/16" over and 1/8" under the specified size.

D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch.

3.3 JOINTING

A. Stone/stone joints and stone/brick joints shall be 3/8" unless specified otherwise.

B. Joint material: Mortar, Type N, ASTM C 270.

C. Use a full bed of mortar at all bed joints.

D. Flush vertical joints full with mortar.

E. Leave all joints with exposed tops or under relieving angles open for sealant.

F. Leave head joints in copings and projecting components open for sealant.

3.4 SETTING CAST STONE IN MORTAR

A. Set units exactly in locations shown in Shop Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.

1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
2. Coordinate installation of cast stone with installation of flashing specified in other Sections.

B. Drench units with clean water prior to setting.

C. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

D. Set units in full bed of mortar unless otherwise noted.

E. Rake mortar joints 3/4" for pointing.

F. Remove excess mortar from unit faces immediately after setting.

G. Tuck point unit joints to a slight concave profile.

H. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.

1. Keep joints free of mortar and other rigid materials.
2. Build in compressible foam-plastic joint fillers where indicated.
3. Form joint of width indicated, but not less recommended by Manufacturer.
4. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Division 07 Section "Joint Sealants."

3.5 ADJUSTING AND CLEANING

A. Protect Cast Stone from staining and chipping before, during, and after installation.

B. Remove and replace stained and otherwise damaged units and units not matching approved Samples.

1. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
2. Minor chips in cast stone may be repaired with patching material furnished by manufacturer, following manufacturer's instructions for use, if approved by Architect.

C. In-Progress Cleaning: Clean cast stone as work progresses.

1. Remove mortar fins and smears before tooling joints.
2. Remove excess sealant immediately, including spills, smears, and spatter.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
3. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
4. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.
    a. Do not use any cleaner not designed for use on concrete without express approval of manufacturer.
    b. Do not clean Cast Stone by power washing or sandblasting without express approval of manufacturer.

3.6 INSPECTION AND ACCEPTANCE

A. Inspect finished work according to Cast Stone Institute Technical Bulletin #36.

B. Inspect under direct daylight conditions.

C. Inspect Cast Stone only when dry.

END OF SECTION 04 72 00

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Structural steel framing members, support members and struts.

B. Base plates, embedded plates, shear stud connectors and expansion joint plates.

C. Grouting under base plates.

1.2 REFERENCE STANDARDS

A. AISC (MANUAL) – Steel Construction Manual; American Institute of Steel Construction, Inc.

B. AISC S303 – Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel Construction, Inc.

C. AISC S348 – Specification for Structural Joints Using Grade A325 or A490 Bolts.

D. ASTM A 36/A 36M – Standard Specification for Carbon Structural Steel.

E. ASTM A 53/A 53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

F. ASTM A 108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished.

G. ASTM A 123/A 123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

H. ASTM A 153/A 153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

I. ASTM A 307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

J. ASTM A 500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

K. ASTM A 563 – Standard Specification for Carbon and Alloy Steel Nuts.

L. ASTM A 992/A 992M – Standard Specification for Structural Steel Shapes.

M. ASTM C 1107/C 1107M – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).

N. ASTM E 94 – Standard Guide for Radiographic Examination.

O. ASTM E164 – Standard Practice for Ultrasonic Contact Examination of Weldments.

P. ASTM E 165 – Standard Test Method for Liquid Penetrant Examination.

Q. ASTM E 709 – Standard Guide for Magnetic Particle Examination.

R. ASTM F 436 – Standard Specification for Hardened Steel Washers.

S. ASTM F 959 – Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.

T. ASTM F 1554 – Standard Specification for Anchor Bolts, Steel, 36, 55 and 105 ksi Yield Strength.

U. ASTM F 3125 – Standard Specification for High Strength Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength

V. AWS A2.4 – Standard Symbols for Welding, Brazing, and Non-Destructive Examination.

1. American Welding Society.

W. AWS D1.1/D1.1M – Structural Welding Code – Steel; American Welding Society.

X. IBC 2021 – International Building Code.

1.3 SUBMITTALS

A. See Section 01 33 00 – Submittal Procedures.

B. Shop Drawings:

1. Indicate profiles, sizes, spacing, and locations of structural members.
2. Include details of cuts, openings, attachments, fasteners, splices and camber.
3. Detail all connections.

a. Indicate pre-tensioned and slip-critical high-strength bolted connections.
b. Indicate welded connections with AWS welding symbols. Include type, size and length.
c. Indicate all AWS weld designations for pre-qualified full and partial penetration welds and detail all joint preparations.

4. Provide erection details for all field welded connections.
5. For structural-steel connections indicated to comply with design loads, connections and structural analysis data shall be signed and sealed by the qualified professional engineer registered in the State of Maryland responsible for their preparation.

C. AISC certification for fabricator and erector or required additional documentation for non-AISC certified fabricator and erector.

D. Mill Test Reports: Signed by manufacturer certifying that the product complies with specified requirements. Indicate structural strength, destructive test analysis and non-destructive test analysis.

E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

F. Quality control test reports for shop and field including ultrasonic test results.

1. Submit certification by a Professional Engineer registered in the State of Maryland that all joint preparation for complete joint penetration welds meet AISC requirements and that all welding procedure specification requirements have been met.

G. LEED Submittals: Comply with Section 01 81 13.

1. MR Credit 2: Environmental Product Declarations.

a. Steel.

1.4 QUALITY ASSURANCE

A. Structural steel shall be domestic origin, produced and supplied from the United States of America only. Refer to the federal “Buy American Act” and applicable local regulations.

B. Fabricate structural steel members in accordance with AISC “Steel Construction Manual” and AISC “Code of Standard Practice for Steel Buildings and Bridges”.

C. Comply with Section 10 of AISC “Code of Standard Practice for Steel Buildings and Bridges” for architecturally exposed structural steel.

D. Welding: Comply with AWS D1.1, “Structural Welding Code-Steel” for procedures, tolerances, appearance and quality.

E. Fabricator: Engage a firm experienced in fabricating structural steel similar to that indicated for this project and within 15 percent this project size, with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.

1. Provide documentation that fabricator has provided material for and erected at least 3 projects within 15 percent of project size and complexity, in the last six years.
2. Allow the Owner’s representative to visit the fabrication plant as required to inspect in place quality control procedures and structural steel fabrication.
3. Fabricators who are not an AISC Certified Building Fabricator (BU), shall meet the following additional requirements:

a. Demonstrate that the fabricator has in place a quality control program for meeting IBC requirements and compliance with AISC recommendations and standards.
b. At no additional cost to the Owner, provide an independent shop inspection for compliance with IBC, AISC and AWS recommendations and standards. The independent inspection agency shall be different than the lead testing agency engaged for the project.
c. Shop inspection tasks required by AISC 360 to be performed by the fabricator’s quality control personnel, shall be overseen by the independent inspector hired by the fabricator.
d. At completion of fabrication, and prior to erecting steel, submit a certificate of compliance signed and sealed by the third party inspector, stating that the steel fabrication complies with the requirements of the construction documents.
e. Shop drawings shall be signed and sealed by a professional engineer, registered in the local jurisdiction, responsible for the design of the connections. The

professional engineer shall carry a minimum of $1,000,000.00 of professional liability insurance.

f. The steel fabricator shall provide field repair details, along with computations, for all required field modifications. The details and calculations shall be signed and sealed by the same professional engineer that certified the shop drawings.

F. Erector: Engage a firm experienced in erecting structural steel similar to that indicated for the project and within 15 percent of this project size, with a record of successful in-service performance.

1. Provide documentation that the erector has erected at least 3 projects within 15 percent of project size and complexity in the last six years.
2. Erectors who are not an AISC Certified Steel Erector (CSE) shall meet the following additional requirements:

a. Provide an erection procedure safety document with cover letter, signed and sealed by a professional engineer registered in the State of Maryland, that states the document has been reviewed and is in conformance with erection procedures required by AISC.

G. Design connections not detailed on the drawings under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State of Maryland.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off the ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
2. Do not store materials on structure in a manner that might cause deterioration, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.6 COORDINATION

A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel angles, Channels and Plates: ASTM A 36/A 36M. ASTM A 572 where plate is noted on plans to have a yield strength of 50 ksi.

B. Steel W Shapes and Tees: ASTM A 992/A 992M.

C. Cold-Formed Structural Tubing: ASTM A 500, Grade C.

D. Pipe: ASTM A 53/A 53M, Grade B, Finish black.

E. Shear Stud Connectors: Made from ASTM A 108 Grade 1015 bars. Headed stud type.

F. Rods: ASTM A 36/A 36M.

G. Structural Bolts and Nuts: Carbon steel, ASTM A 307, Grade A.

H. High-Strength Structural Bolts, Nuts, and Washers: Grade A 325, with matching ASTM A 563 nuts and ASTM F 436 washers; Type 1, medium carbon, plain. Bolts and nuts shall be heavy hex.

I. High Strength Structural Bolts: Grade A 490, with matching ASTM A 563 nuts and ASTM F 436 washers; Type 1 alloy steel. Bolts and nuts shall be heavy hex.

J. Anchor Rods: ASTM F 1554, Grade 36, plain, with matching ASTM A 563 nuts and ASTM F 436 washers.

K. Load Indicator Washers: Provide washers complying with ASTM F 959 at all connections requiring pre-tensioned high-strength bolts.

L. Welding Materials: AWS D1.1; type required for materials being welded.

M. Grout: Non-shrink, non-metallic aggregate type, complying with ASTM C 1107/C 1107M and capable of developing a minimum compressive strength of 7,000 psi at 28 days.

N. Shop and Touch-Up Primer: Type specified in Section 09 91 20, complying with VOC limitations of authorities having jurisdiction.

O. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.2 FABRICATION

A. Shop fabricate to the greatest extent possible.

B. Develop required camber for members.

C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements of AWS D1.1.

D. Bolt Holes: Drill or punch standard bolt holes perpendicular to metal surfaces.

E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

2.3 FINISH

A. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted with slip-critical connections.

B. Surface preparation: SSPC-SP2: "Hand Tool Cleaning" or SSPC-SP3, "Power Tool Cleaning".

1. Refer to Division 9 for preparation of surfaces that are to receive coatings other than shop primer.

C. Provide a dry film thickness of not less than 1.5 mil.

D. Galvanize structural steel members to comply with ASTM A 123/A 123M. Provide minimum 1.7 oz/sq ft. galvanized coating. Galvanize shelf angles, lintels and hung plates located in exterior walls. Galvanize all exterior steel.

2.4 SOURCE QUALITY CONTROL

A. An independent testing agency will perform source quality control tests, as specified in Division 1. Inspection services shall conform to Section 1705.2 of the 2021 IBC Code, the quality assurance inspection requirements of AISC 360 and the Statement of Special inspections noted in the structural drawings.

B. High-Strength Bolts: Provide testing and verification of all shop-bolted connections in accordance with AISC “Specification for Structural Joints Using Grade A 325 or A 490 Bolts”.

1. Pre-tensioned and slip-critical bolts shall be installed using direct-tension-indicator washer method or twist-off type tension control bolt method.

C. Welded Connections: Visually inspect all shop-welded connections and test all full penetration welds using ultrasonic testing performed in accordance with ASTM E 164.

1. Inspect all joint preparations for complete joint penetration welds and verify compliance with welding procedure specification requirements.

PART 3 - EXECUTION

3.1 ERECTION

A. Erect structural steel in compliance with AISC “Code of Standard Practice for Steel Buildings and Bridges”.

B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Field weld components indicated on shop drawings.

D. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer’s written instructions.

E. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with AISC “Specification for Structural Joints Using Grade A 325 or A 490 Bolts”.

F. Do not field cut or alter structural members without the approval of the Architect.

G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete and surfaces that will be fireproofed. Repair damaged galvanized coatings with galvanized repair paint.

H. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for non-shrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.2 TOLERANCES

A. Maintain erection tolerances of structural steel and architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges".

3.3 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Division 1. Inspection services shall conform to Section 1705.2 of the 2021 IBC Code, the quality assurance inspection requirements of AISC 360 and the Statement of Special Inspections noted in the structural drawings.

B. High-Strength Bolts: Provide testing and verification of all field-bolted connections in accordance with AISC "Specification for Structural Joints Using Grade A 325 or A 490 Bolts".

1. Pre-tensioned and slip-critical bolts shall be installed using direct-tension-indicator washer method or twist-off type tension control bolt method.

C. Welded Connections: Visually inspect all field-welded connections and test all full penetration welds using ultrasonic testing performed in accordance with ASTM E 164.

1. Inspect all joint preparations for complete joint penetration welds and verify compliance with welding procedure specification requirements.

D. In addition to visual inspection, field-welded shear connectors shall be tested and inspected according to the requirements of AWS D1.1 for stud welding.

E. Correct deficiencies in work that inspections indicate does not comply with the specified requirements.

END OF SECTION 05 12 00

SECTION 05 21 00 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Open web steel joists, with bridging, attached seats and anchors.

B. Loose bearing members, such as plates and anchor bolts for site placement.

C. Joist accessories.

1.2 REFERENCE STANDARDS

A. AISC S348 – Specification for Structural Joints Using Grade A 325 or A 490 bolts.

B. ASTM A 36/A 36M – Standard Specification for Carbon Structural Steel.

C. ASTM F 3125 – Standard Specification for High Strength Bolts and Assemblies, Steel and Allow Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength

D. ASTM E 94 – Standard Guide for Radiographic Examination.

E. ASTM E 164 – Standard Practice for Ultrasonic Contact Examination of Weldments.

F. ASTM E 165 – Standard Test Method for Liquid Penetrant Examination.

G. ASTM E 709 – Standard Guide for Magnetic Particle Examination.

H. AWS D1.1/D1.1M – Structural Welding Code – Steel; American Welding Society.

I. SJI (SPEC) – Catalog of Standard Specifications and Load Tables for Steel Joists and Joist Girders; Steel Joist Institute.

J. SSPC-SP 2 – Hand Tool Cleaning; Society for Protective Coating.

K. IBC 2021 – International Building Code.

1.3 SPECIAL JOISTS

A. Design special joists to withstand design loads indicated with live load deflection no greater than L/360 of the span.

1.4 SUBMITTALS

A. See Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Show layout, designation, number, type, location, and spacing of joists. Include joining and anchorage details, bracing, bridging, joist accessories, splice and connection locations and details; and attachments to other construction.

1. Indicate locations and details of bearing plates to be embedded in other construction.

2. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer licensed in the State of Maryland who is responsible for its preparation.

C. Welding Certificates.

D. Manufacturer's Certificates: Signed by manufacturers certifying that joists comply with requirements.

E. Manufacturer's Mill Certificates: Signed by bolt manufacturers certifying that bolts comply with requirements.

F. LEED Submittals: Comply with Section 01 81 13.

1. MR Credit 2: Environmental Product Declarations.

a. Steel joist.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable specifications and load tables of SJI "Specifications".

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. SJI Specifications: Comply with standard specification in SJI's "Specifications" that are applicable to types of joists indicated.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M "Structural Welding Code – Steel".

PART 2 - PRODUCTS

2.1 MATERIALS

A. Open Web Joists: SJI Type K and KCS Joists:

1. Provide bottom and top chord extensions as indicated.
2. Finish: Shop primed.

B. Steel: Comply with SJI's Specifications for web and angle chord members.

C. High-Strength Bolts, Nuts, and Washers: Grade A 325, Type 1, heavy hex steel bolts with ASTM A 563 heavy hex nuts and ASTM F 436 washers; plain.

D. Structural Steel for Supplementary Framing: ASTM A 36/A 36M.

E. Welding Materials: AWS D1.1; type required for materials being welded.

F. Shop and Touch-Up Primer: Type specified in Section 09 91 20, complying with VOC limitations of authorities having jurisdiction.

2.2 FABRICATION

A. Manufacture steel joists to meet SJI's "Specifications", with steel angle top and bottom- chord members; of joist type and end and top-chord arrangements as indicated.

B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. Provide holes in chord members for connecting and securing other construction to joists.

D. Camber steel joists according to SJI's "Specifications".

E. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds ¼ inch per twelve inches.

F. Bridging: Provide bridging anchors and number of rows of horizontal and diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Provide additional erection bridging if required for stability and where indicated on the Drawings.

G. Fabricate steel bearing plates with integral anchorages of sizes and thicknesses indicated. Shop prime paint.

H. Supply ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within ½ inch of finished wall surface unless otherwise indicated.

I. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.3 FINISH

A. Prepare surfaces to be finished in accordance with SSPC-SP 2.

B. Apply shop primer to joists and joist accessories to provide a continuous dry paint film not less than 2 mil thick; apply two coats of shop primer if necessary to meet specified dry film thickness.

PART 3 - EXECUTION

3.1 ERECTION

A. Erect joists with correct bearing on supports.

B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.

C. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.

D. Coordinate placement of anchors in concrete and masonry construction for securing bearing plates.

E. Position and field weld joist chord extensions and wall attachments as detailed.

F. Do not permit erection of decking until joists are braced, bridged, and secured or until completion of erection and installation of permanent bridging and bracing.

G. Do not field cut or alter structural members without approval of joist manufacturer.

H. After erection, prime welds and damaged shop primer, except surfaces specified not to be primed.

3.2 TOLERANCES

A. Maximum Variation From Plumb: ¼ inch.

B. Maximum Offset From True Alignment: ¼ inch.

3.3 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Division 1. Inspection services shall conform to Section 1705.2 of the 2021 IBC Code and the Statement of Special Inspections noted in the structural drawings.

B. High-Strength Bolts: Provide testing and verification of all field-bolted connections in accordance with AISC “Specification for Structural Joists Using Grade A 325 or A 490 Bolts”.

C. Welded Connections: Visually inspect all field-welded connections and test 100 percent of full-penetration welds using ultrasonic testing performed in accordance with ASTM E 164.

D. Correct deficiencies in work that inspections indicate are not in compliance with specified requirements.

END OF SECTION 05 21 00

SECTION 05 31 00 - STEEL DECKING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Roof deck.

B. Composite floor deck.

C. Supplementary framing for openings up to and including 12 inches.

D. Bearing plates and angles.

E. Stud shear connectors.

1.2 REFERENCE STANDARDS

A. ASTM A 36/A 36M – Standard Specification for Carbon Structural Steel.

B. ASTM A 108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.

C. ASTM A 653/A 653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

D. ASTM A 1008/A 1008M – Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened.

E. AWS D1.1/D1.1M – Structural Welding Code – Steel; American Welding Society.

F. AWS D1.3 – Structural Welding Code – Sheet Steel, American Welding Society.

G. SDI (DM) – Publication No. 31, Design Manual for Composite Decks, Form Decks, Roof Decks; Steel Deck Institute.

H. SSPC-Paint 20 – Zinc-Rich Primers (Type I, “Inorganic”, and Type II “Organic”); The Society for Protective Coatings.

1.3 SUBMITTALS

A. See Section 01 33 00 – Submittals Procedures.

B. Shop Drawings: Indicate deck plan, support locations, anchorage details, projections, openings, reinforcement, cellular raceways and outlet box locations, pertinent details, and accessories.

C. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.

D. Certificates: Certify that products furnished meet or exceed specified requirements.

E. Welders Certificates: Certify welders employed on the Work are certified to perform welding according to AWS requirements with AWS 1.3 qualification within the previous twelve months.

F. LEED Submittals: Comply with Section 01 81 13.

1. MR Credit 2: Environmental Product Declarations.

a. Steel decking.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this Section with minimum of 5 years of documented experience.

1.5 DELIVERY, STORAGE AND HANDLING

A. Cut plastic wrap to encourage ventilation.

B. Separate sheets and store deck on dry wood sleepers, slope for positive drainage.

PART 2 - PRODUCTS

2.1 STEEL DECK

A. Roof Deck: Non-composite type, fluted steel sheet.

1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), with G60/Z180 galvanized coating.

a. Grade 40.

B. Composite Floor Deck: Fluted steel sheet embossed to interlock with concrete.

1. Galvanized Steel Sheet: ASTM A 653/A 653M, Designation SS, with G60/Z180 galvanized coating.

a. Grade 40.

2.2 ACCESSORY MATERIALS

A. Bearing Plates and Angles: ASTM A 36/A 36M steel.

B. Stud Shear Connectors: Made from ASTM A 108/A 108M Grade 1015 bars.

C. Welding Materials: AWS D1.1.

D. Fasteners: Galvanized hardened steel, self tapping screws, No. 10 minimum.

E. Weld Washers: Mild steel, uncoated, ¾ inch outside diameter, 1/8 inch thick.

F. Shop and Touch-Up Primer: Type specified in Section 09 91 20, complying with VOC limitations of authorities having jurisdiction.

G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.

H. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.

I. Acoustical Insulation: Glass fiber type, minimum 1.1 lb/cu. ft. density; profiled to suit deck.

2.3 FABRICATED DECK ACCESSORIES

A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 20 gage minimum thick sheet steel; of profile and size as indicated; material and finish same as deck.

B. Cant Strips: Formed sheet steel, 16 gage thick, 45 degree slope, 3½ inch nominal width and height, flange for attachment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.2 INSTALLATION

A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.

B. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before permanently fastening.

C. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck and support of other work.

D. Weld deck in accordance with AWS D1.3.

E. Where deck changes direction, install 6 inch minimum wide sheet steel cover plates, of same thickness as deck. Fusion weld 12 inches on center maximum.

F. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete. Provide stops of sufficient strength to remain stationary without distortion.

G. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.

H. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.

I. Place metal cant strips in position and field weld.

J. Weld stud shear connectors through steel deck to structural members below.

K. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

3.3 ROOF DECK INSTALLATION

A. Fasten roof deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1½ inches long, and as follows:

1. Weld Diameter: 3/4 inch, nominal.
2. Weld Spacing: Weld edge ribs of panel at each support; space additional welds at 12” o.c. and as indicated on Drawings.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 36 inches, and as indicated on Drawings.

1. Mechanically fasten with self-drilling, No.10 diameter or larger, carbon-steel screws.
2. Fasten with a minimum of 1½ inch-long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1½ inches, with end joints lapped 2 inches minimum.

3.4 FLOOR DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: 3/4 inch, nominal.
2. Weld Spacing: Weld edge ribs of panel at each support and at 12” on center.

B. Side-lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches, and as indicated on Drawings.

1. Fasten with a minimum of 1½ inch long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1½ inches, with end joints butted.

3.5 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Division 1. Inspection services shall conform to Section 1705.2 of the 2021 IBC Code and the Statement of Special Inspections noted in the structural drawings.

B. Inspection shall include, but not be limited to, deck alignment, support, welds, side lap attachments and touch-up galvanizing.

C. Remove and replace work that does not comply with specified requirements.

END OF SECTION 05 31 00

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Exterior non-load-bearing wall framing.

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
2. Division 07 Section "Thermal Insulation" for insulation installed in exterior wall framing.
3. Division 09 Section "Gypsum Board Shaft-Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
4. Division 09 Section “Non-Structural Metal Framing” for interior non-load-bearing, metal-stud-framing wall assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
3. Indicate component details, framed openings, bearing, anchorage, loading, welds, type and location of fasteners, and accessories or items required of related work.

C. Delegated-Design Submittal: Provide details, shop drawings and calculations stamped by a Professional Structural Engineer licensed in the State of Maryland.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of code-compliance certification for studs and tracks.

C. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips.
7. Miscellaneous structural clips and accessories.
8. 14 Gauge Rigid Connection Clips

D. Research/Evaluation Reports: For cold-formed metal framing.

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

D. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."
2. Maintain one copy of document on project site.

1.6 MOCKUPS

A. Include cold-formed metal framing in integrated exterior mockup that will be used to demonstrate perform preconstruction testing and to set quality standards for materials and installation. See Division 01 Section "Mockups" for additional construction requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:

1. ClarkDietrich.
2. Marino\WARE.
3. National Gypsum Co.; Gold Bond Building Products Division.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: Axial and lateral load bearing elements shall be designed to the following conditions unless more stringent requirements are imposed by governing code; these requirements take precedent when more stringent than governing code.
   a. Gravity Loads: Per ASCE 7-2016.
   b. Wind and Seismic Loads: Per ASCE 7-2016.

2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
   a. Backing of Masonry Veneer and Stone: 1:600 of span.
   b. Other Systems: 1:240 of span.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design to AISI SG-973 Cold-Formed Steel Design Manual.
5. Design to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
6. Design to meet loading and anchorage requirements for window systems and curtainwall system based on calculations provided by the respective subcontractors.
7. Seismic Loads: Design and size components to withstand seismic loads and sway displacement as in accordance with IBC code.
8. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

   a. Upward and downward movement of 1 inch.

9. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
10. Interior Non-Load-Bearing Wall Framing: Steel framing / studs shall be of a configuration and gauge to provide sufficient stiffness, as controlled by the maximum allowable horizontal deflection of L/360 of the wall height under a horizontal load of 10 lbf/sq. ft. in all areas (U.N.O.).
11. Soffit / Ceiling Framing: Vertical deflection of 1/360 of the horizontally projected span for live load and 1/240 for total loads in all areas.

C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:

1. Floor and Roof Systems: AISI S210.
2. Wall Studs: AISI S211.
3. Headers: AISI S212.
4. Lateral Design: AISI S213.

2.3 MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: ST33H or as required by structural performance.
2. Coating: G90.

B. Steel Sheet for Vertical Deflection clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.
2. Coating: G90.

C. Steel studs 18 gauge and lighter components: Fabricate components of commercial quality steel sheet (ASTM A446 for galvanized finish) with a minimum yield point of 33,000 psi.

D. Steel studs 16 gauge and heavier components: Fabricate components of structural quality steel sheet (ASTM A446 for galvanized finish) with a minimum yield point of 50,000 psi.

E. Track and bridging components: Fabricate components of commercial quality steel sheet (ASTM A446 for galvanized finish) with a minimum yield point of 33,000 psi.

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch.
2. Flange Width: 1-5/8 inches.
3. Galvanized Steel Sheet: ASTM A 653/A 653M Structural Steel (SS) with G90/Z275 hot-dipped galvanized coating.
4. Gauge and depth: As indicated on drawings and as required to meet specified performance levels.

5. Grade: As indicated on drawings.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch.
2. Flange Width: 1-1/4 inches.
3. Galvanized Steel Sheet: ASTM A 653/A 653M Structural Steel (SS) with G90/Z275 hot-dipped galvanized coating.
4. Gauge and depth: As indicated on the drawings and as required to meet specified performance levels.
5. Grade: As indicated on drawings.

C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch.
2. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications,

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:

a. Minimum Base-Metal Thickness: 0.0538 inch.
b. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications,

2. Inner Track: Of web depth indicated, and as follows:

a. Minimum Base-Metal Thickness: 0.0538 inch.
b. Flange Width: Sum of outer deflection track flange width plus 1 inch.

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

G. 14 Gauge Rigid Connection Clip: Manufacturer’s rigid framing clip used to attach exterior wall studs to the structure of the building. Designed to transfer horizontal and vertical loads, the extended rigid clips install easily with screws, powder-actuated fasteners, or welds. This clip is ideal for all medium and large standoff conditions.

2.5 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole-reinforcing plates.
11. Backer plates.

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780/A780M or SSPC-Paint 20.

B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.

D. Shims: Load-bearing, high-density multimonomer, nonleaching plastic.

E. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

2.8 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

3.4 INSTALLATION OF EXTERIOR NON-LOAD BEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches or as indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to bypassing or infill studs and anchor to building structure.
4. Connect drift clips to cold formed steel framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.5 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.6 FIELD QUALITY CONTROL

A. Testing: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for overhead doors.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Steel shapes for supporting elevator door sills.
5. Elevator pit sump covers.
6. Miscellaneous steel trim including steel angle corner guards steel edgings.
7. Metal bollards for sally port.
8. Loose bearing and leveling plates for applications where they are not specified in other Sections.
9. Steel pipe and tube railings.
10. Interior Steel Stairs.
11. Steel grating platforms and stairs at roof.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Requirements:

1. Division 03 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Division 04 Section "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
3. Division 05 Section "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.
4. Division 05 Section “Decorative Railing Systems”.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for overhead doors.
2. Steel framing and supports for countertops.
3. Steel framing and supports for mechanical and electrical equipment.
4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
5. Steel shapes for supporting elevator door sills.
6. Elevator pit sump covers.
7. Miscellaneous steel trim including steel angle corner guards, steel edgings, and, loading-dock edge angles.
8. Metal bollards.
9. Loose steel lintels.

C. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.

B. Thermal Movements: For exterior metalwork, allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.

D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.

E. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

F. Rolled-Stainless Steel Floor Plate: ASTM A793.

G. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

H. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

I. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

J. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

K. Aluminum Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.

L. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.

M. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.

N. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

O. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500.

P. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide bronze fasteners for fastening bronze.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593 (ASTM F738M); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 1 (A1).

D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

F. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

G. Post-Installed Anchors:

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2.4 MISCELLANEOUS MATERIALS

A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

E. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

F. Concrete: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 STEEL STAIRS

A. Description of Steel Stairs:

1. Fire Stairs: Shop fabricated steel stairs with concrete-filled treads. Steel pipe guardrails with steel pickets and steel pipe handrails as detailed on the drawings. Final assembly and welding in field.

2. Roof Stairs: In accordance with this specification and as detailed on the structural drawings.

B. Description of Steel Stair Framing:

1. Fabricate stringers of steel channels (Stair N1ST2) or steel plates (Stair N1ST1).

2. Construct platforms of steel channels and plate with steel headers and miscellaneous framing members.

3. If using bolts (Stairs N1ST2 only), fabricate and join so bolts are not exposed on finished surfaces.

4. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

5. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.0677 inch (1.7 mm).

C. Structural Performance of Metal Stairs: Capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved:

1. Treads and Platforms of Metal Stairs: Uniform load of 100 lbf/sq. ft. (4.79 kN/sq. m) or a concentrated load of 300 lbf (1.33 kN) on an area of 4 sq. in. (25.8 sq. cm), in addition to flooring and setting bed, whichever produces the greater stress.

2. Uniform and concentrated loads need not be assumed to act concurrently.

3. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.

4. Deflection: Limit deflection of treads, platforms, and framing members to L/240 for Fire Stairs.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

2.8 ELEVATOR PIT SUMP COVERS

A. Fabricate from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 3/4 inch in least dimension.

B. Provide steel angle supports unless otherwise indicated.

2.9 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize and prime exterior miscellaneous steel trim.

D. Prime miscellaneous steel trim with zinc-rich primer.

2.10 METAL BOLLARDS

A. SEE LA FOR CRASH RATED BOLLARDS ON SITE

B. Fabricate metal bollards from Schedule 80 steel pipe located at the sallyport.

C. Fabricate interior bollards with 3/8-inch-thick, steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.

1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.

D. Fabricate internal sleeves for removable bollards from Schedule 80 steel pipe with an OD approximately 1/16 inch less than ID of bollards. Match drill sleeve and bollard for 3/4-inch steel machine bolt.

E. Galvanize and prime exterior steel bollards.

F. Prime steel bollards with zinc-rich primer.

G. Provide safety yellow exterior finishes paint.

H. Provide reflective paint stripe on exterior pf bollard.

2.11 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize bearing and leveling plates.

C. Prime plates with zinc-rich primer.

2.12 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Galvanize and prime loose steel lintels located in exterior walls.

C. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.13 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.14 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer unless zinc-rich primer is indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions, ceiling hung toilet partitions, and overhead doors securely to, and rigidly brace from, building structure.

3.3 INSTALLATION OF METAL BOLLARDS

A. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

B. Fill bollards solidly with concrete, mounding top surface to shed water.

1. Do not fill removable bollards with concrete.

3.4 INSTALLATION OF NOSINGS, TREADS, AND THRESHOLDS

A. Center nosings on tread widths unless otherwise indicated.

B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

C. Seal thresholds exposed to exterior with elastomeric sealant complying with Division 07 Section "Joint Sealants" to provide a watertight installation.

3.5 INSTALLATION OF BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 REPAIRS

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 50 00

SECTION 05 52 13.13 - PIPE AND TUBE RAILINGS - SITE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Stainless-steel pipe railings at site stairs with base plate

B. Related Requirements:
   1. Section 057300 "Decorative Metal Railings" for ornamental railings fabricated from pipes and tubes.

1.3 COORDINATION

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

   1. Manufacturer's product lines of mechanically connected railings.
   2. Railing brackets.
   3. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

   1. Sections of each distinctly different linear railing member, including handrails, top rails and posts.
   2. Fittings and brackets.
   3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.

a. Show method of connecting and finishing members at intersections.

D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

D. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

E. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Stainless-Steel Pipe Railings

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change : 120 deg F ambient ; 180 deg F

2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.4 STAINLESS STEEL

A. Tubing: ASTM A 554, Grade MT 304.

B. Pipe: ASTM A 312/A 312M, Grade TP 304.

C. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.

D. Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

2.5 FASTENERS

A. General: Provide the following:

1. Stainless-Steel Railings: Type 304 stainless-steel fasteners.
2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
3. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For stainless-steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

D. Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.7 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Non-welded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

J. Form Changes in Direction as Follows:

1. As detailed.

K. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of railing members with prefabricated end fittings.

M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

P. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

2.8 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines, or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Dull Satin Finish: No. 6

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

B. Verify that all railing meets local, ADA and building codes prior to fabrication. Notify landscape architect of any discrepancy immediately and prior to fabrication and installation.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.

3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Non-welded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.

D. Leave anchorage joint exposed with 1/8-inch buildup, sloped away from post.

E. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
1. For stainless-steel pipe railings, weld flanges to post and bolt to supporting surfaces.

3.5 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

C. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.

3.6 ADJUSTING AND CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05 52 13

SECTION 05 73 00 – DECORATIVE METAL RAILING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. Provide ornamental guardrails and railings where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Section Includes:

1. Interior railing system for stairs and landings.
2. Exterior railing system for stair in mechanical well.

C. Similar work is specified as follows:

1. Steel pipe and tube handrails and railing systems not attached to metal stairs or to walls adjacent to metal stairs are specified in Division 5 Section Metal Fabrications.

D. Products Furnished but not Installed under this Section:

1. Cast-in-place anchors, inserts, and similar anchorage devices specified under other sections.

E. Related Documents/Sections: Carefully examine the Contract Documents for requirements which affect work of this Section. Documents and specification sections containing requirements which relate to this Section include, but are not necessarily limited to:

1. General and Supplementary Conditions and sections in Division 1 of these Specifications.
2. Division 3 Section - Cast-In-Place Concrete.

1.3 DEFINITIONS

A. Definitions in ASTM E 985 for railing-related terms apply to this Section.

1.4 PERFORMANCE REQUIREMENTS

A. General: In engineering guardrail and railing systems to withstand structural loads indicated, determine allowable design working stresses of materials based on the following:

1. Cold Formed Structural Steel: ANSI "Specifications for the Design of Cold-Formed Steel Structural Members".

B. Structural Performance of Guardrails and Railing Systems: Engineer, fabricate, and install guardrails and railing systems to withstand the following structural loads without exceeding the allowable design

working stress of the materials for guardrails, railing systems, anchors, and connections. Apply each load to produce the maximum stress in each of the respective components comprising guardrails and railing systems.

1. Top Rail of Guardrail Systems: Capable of withstanding the following loads applied as indicated:

    a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
    b. Uniform load of 50 lbf per linear foot (730 N/m) applied horizontally and concurrently with uniform load of 100 lbf per linear foot (1460 N/m) applied vertically downward.
    c. Concentrated and uniform loads above need not be assumed to act concurrently.

2. Guardrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:

    a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
    b. Uniform load of 50 lbf per linear foot (730 N/m) applied in any direction.
    c. Concentrated and uniform loads above need not be assumed to act concurrently.

3. Infill Area of Guardrail Systems: Capable of withstanding a horizontal concentrated load of 200 lbf (890 N) applied to 1 sq. ft. (0.09 sq. m) at any point in the system, including panels, intermediate rails, balusters, or other elements composing the infill area.

    a. Above load need not be assumed to act concurrently with loads on top rails of railing systems in determining stress on guard.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 SUBMITTALS

A. General:

1. Identify proposed changes, differences, and discrepancies, including verbiage, terms, and definitions, between Contract Documents and submittals.

B. Product Data:

1. For each type of product indicated, submit manufacturer's specifications and other data needed to prove compliance with the specified requirements.

    a. Submit data for mechanically connected guardrails and railing systems, each kind of fitting and paint products.

C. Shop Drawings:

1. Submit drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with the work of adjacent trades.

    a. Show fabrication and installation of guardrails and railing systems including plans, elevations, sections, details of components, and attachments to other units of Work.

b. For installed guardrails and railing systems indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional engineer who was responsible for their preparation.

D. Samples:

1. Samples for Initial Selection:

a. Samples in the form of short sections of railing or flat sheet metal samples showing available mechanical finishes.

2. Samples for Verification Purposes:

a. Assembled finished sample of railing system, made from full-size components, including top rail, post, guardrail, and infill. Show finishing of members at intersections.
b. 6-inch-long sections of each distinctly different linear railing member, including guardrails, top rails, posts, and intermediate members.
c. Welded connections.
d. Each different fitting and bracket.

E. Quality Control Submittals:

1. Tests:

a. Product test reports from a qualified independent testing agency evidencing compliance of guardrails and railing systems with requirements based on comprehensive testing of current products.

2. Certificates:

a. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
b. Welder certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" article.

3. Qualification Data:

a. Submit data for firms and persons specified under "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project name(s), address(es), names of Architect(s) and Owner(s), plus other specified information. This must be approved by the architect.

4. Manufacturer's Instructions:

a. Submit manufacturer's recommended installation procedures which, when reviewed by the Architect, may become the basis for accepting or rejecting actual installation procedures used on the work.

F. Contract Closeout Submittals:

1. Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Architect requisite copies of the following:

a. Project Record Documents.
b. Operation and Maintenance Data.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

B. Single-Source Responsibility: Obtain guardrails and railing systems of each type and material from a single manufacturer.

C. Engineer Qualifications: A professional engineer legally authorized to practice in the jurisdiction where Project is located and experienced in providing engineering services of the kind indicated that have resulted in the installation of guardrails and railing systems similar to this Project in material, design, and extent and that have a record of successful in-service performance.

D. Qualifications for Welding Work: Qualify welding procedures and welding operators in accordance with AWS "Qualification" requirements.

1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests (AWS D1.2) and can document a minimum of five years successful experience in aluminum TIG welding.
2. If recertification of welders is required, retesting will be Contractor's responsibility.

1.7 STORAGE

A. Store guardrails and railing systems inside a well-ventilated area, away from uncured concrete and masonry and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

1.8 PROJECT CONDITIONS

A. Field Measurements: Where guardrails and railings are indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating guardrails and railing systems without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

1.9 SEQUENCING AND SCHEDULING

A. Sequence and coordinate installation of guardrails as follows:

1. Mount guardrails only on completed Work. Do not support guardrails temporarily by any means not satisfying structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Railings: Subject to compliance with requirements provide railing systems by one but not limited to equals of the follow of the following:

1. Interior Railing System:

a. McNichols Company
9070 Junction Dr. #M
Annapolis Junction, MD 20701-1141
Tel: 1.877.884.4653

2. Expanded Metal Fabric:

a. McNichols Company
9070 Junction Dr. #M
Annapolis Junction, MD 20701-1141
Tel: 1.877.884.4653

2.2 METALS

A. General: Provide metal free from surface blemishes where exposed to view in the finished unit. Exposed-to-view surfaces exhibiting pitting, seam marks, roller marks, stains, discolorations, or other imperfections on finished units are not acceptable.

B. Brackets, Flanges, and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

C. Steel: Provide steel and iron in the form indicated complying with the following requirements:

a. Steel Tubing: Product type (manufacturing method) and other requirements as follows:

1) Cold-Formed Steel Tubing: ASTM A 500, grade as indicated below:
2) Grade A, unless otherwise indicated or required by structural loads.
3) Hot-Formed Steel Tubing: ASTM A 501.
4) Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

b. Steel Tube Posts: 1 ½” x 1 ½”” square steel powder coated in shop.
c. Steel Tube Toprail: 1 ½” x 2” rectangular steel powder coated in shop.

D. Brackets, Flanges, and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

1. Railing brackets mounted on steel posts: McNichols, stainless steel No. 304.
2. Adapter for Wall Brackets mounted on steel posts; McNichols handrail adapter. Brushed stainless steel No. 304.

E. Ornamental Grade Stainless Steel No. 304 Finish Handrail Mouldings:

1. McNichols 1 ¼" nominal schedule 40 handrail pipe.
2. Ornamental Grade Finish finished and polished by the shop fabricator.
3. Handrail O.D. = 1.660".
4. Provide McNichols Connector pieces to be utilized with shop welded connections.
5. Provide custom welded closed end caps.

E. Ornamental Grade Expanded Metal Fabric:

1. McNichols Quality Square Welded Wire Mesh, Stainless Steel Type 304, 3" Square Opening, 0.2500" Wire Diameter, Welded Untrimmed, 85% Open Area, Sheet, 48.0000" x 120.0000"

F. Ornamental U-Channel Edging"
1. McNICHOLS® Quality U Edging, Stainless Steel Type 304, 16 Gauge, Type 402, 1/2" Opening, Piece, 1.0000" Width x 120.0000" Length

G. Ornamental Connectors:
1. McNICHOLS® Quality U Edging, Stainless Steel Type 304, 16 Gauge, Type 402, 1/2" Opening, Piece, 1.0000" Width x 120.0000" Length

2.3 MISCELLANEOUS MATERIALS

A. Filler Metal and Electrodes: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded or brazed and as required for color match, strength, corrosion resistance, and compatibility in fabricated items.

2.4 FASTENERS

A. Fasteners for Anchoring Railings to Other Construction: Select fasteners of the type, grade, and class required to produce connections that are suitable for anchoring railing to other types of construction indicated and capable of withstanding design loadings.

1. Provide fasteners fabricated from type 304 or type 316 stainless steel.

B. Interconnecting Railing Components:

1. Provide structural TIG welds.

C. Cast-in-Place and Postinstalled Anchors: Anchors of type indicated below, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. Cast-in-place anchors.

D. For steel railings and fittings, use plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.

2.5 PAINT

A. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers.

B. Shop Primers for Steel: Provide primers complying with applicable requirements of Division 9 Section “Painting”.

2.6 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

B. Products: Subject to compliance with requirements, provide one of the following:

1. B-6 Construction Grout; W. R. Bonsal Co.
2. Euco N-S Grout; Euclid Chemical Co.
3. Masterflow 928 and 713; Master Builders Technologies, Inc.
4. Sonogrout 14; Sonneborn Building Products--ChemRex, Inc.

2.7 FABRICATION

A. Fabricate guardrails and railing systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of hollow members, post spacings, and anchorage, but not less than that required to support structural loads.

B. Assemble railing systems and guardrails by use of structural TIG welds (both shop and field).

1. Obtain fusion without undercut or overlap.

a. Bevel edges as required to allow deep penetration.
b. Provide sufficient weld depth on front and back intersecting surfaces to allow welds to be ground smooth and flush for architectural quality appearance and to maintain structural adequacy.

2. Remove welding flux immediately.
3. Finish exposed welds and surfaces so that no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

C. Form changes in direction of railing members as indicated.

D. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated.

E. Close exposed ends of guardrail and railing members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted guardrails, unless otherwise indicated. Close ends of returns unless clearance between end of the railing and wall is 1/4 inch (6 mm) or less.

G. Provide internal weep holes at intersections to allow discharge of moisture.

H. Assemble railing systems in shop to the greatest extent possible to minimize field splicing and assembly.

1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.

I. Provide brackets, flanges, miscellaneous fittings, and anchors to connect guardrail and railing members to other construction.

J. Provide inserts and other anchorage devices to connect guardrails and railing systems to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by guardrails and railing systems. Coordinate anchorage devices with supporting structure.

K. For steel railings to be radius bends as shown on the drawings.

2.8 FINISHES, GENERAL

A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering prior to shipment.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one half of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and they are assembled or installed to minimize contrast.

D. Finish: shop primed and painted for interior and exterior paint finish systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installing anchorages, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having integral anchors, that are to be embedded in concrete as masonry construction. Coordinate delivery of such items to Project site.

3.2 INSTALLATION, GENERAL

A. Fit field connections accurately together to form tight, hairline joints.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing guardrails and railings. Set guardrails and railings accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.

1. Do not weld, cut, or abrade surfaces of guardrails and railing components that have been coated or finished after fabrication and are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/4 inch in 12 feet (2 mm in 1 m).
3. Align rails so that variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (2 mm in 1 m).

C. Shop and Field Welding:

1. Assemble railing systems and guardrails by use of structural TIG welds (both shop and field).
2. Obtain fusion without undercut or overlap.

a. Bevel edges as required to allow deep penetration.
b. Provide sufficient weld depth on front and back intersecting surfaces to allow welds to be ground smooth and flush for architectural quality appearance and to maintain structural adequacy.

3. Remove welding flux immediately.
4. Finish exposed welds and surfaces so that no roughness shows after finishing and welded surface matches contours and color of adjoining surfaces.

D. Adjust guardrails and railing systems prior to anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated but not less than that required by structural loads.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing guardrails and railings systems and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components by welding. Cope or butt components to provide 100 percent contact, or use fittings designed for this purpose.

3.4 ATTACHING GUARDRAILS TO WALLS

A. Attach guardrails to wall with wall brackets and end fittings. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of guardrail and finished wall surface.

B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets and wall return fittings to building construction as follows:

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.

3.6 PROTECTION

A. Protect finishes of railing systems and guardrails from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 73 00

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Rooftop equipment bases and support curbs.
3. Wood blocking, cants, and nailers.
4. Wood furring and grounds.
5. Wood sleepers.
6. Plywood backing panels
7. Laminate Strand Lumber (LSL) Parapet Cap
8. Fasteners

B. Related Requirements:

1. Division 06 Section "Sheathing" for wall sheathing, subflooring, and underlayment.
2. Division 06 Section "Interior Architectural Woodwork" for interior woodwork.
3. Division 07 Section "Thermal Insulation" for ventilated nail base insulated roof sheathing.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. OSB: Oriented strand board.

E. Lumber grading agencies, and abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. SPIB: The Southern Pine Inspection Bureau.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and product indicated, submit manufacturer's specifications and other data needed to prove compliance with the specified requirements. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.

1.6 MOCKUPS

A. Include rough carpentry in integrated exterior mockup that will be used to demonstrate aesthetic effects, perform preconstruction testing, and to set quality standards for materials and installation. See Division 01 Section "Mockups" for additional construction requirements.

1. Build mockup as indicated on Drawings complete with wood nailers, blocking, etc.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber:

1. Boards: 15 percent.
2. Dimension Lumber: 15 percent unless otherwise indicated.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 PRESERVATIVE TREATMENT

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC3b for exterior construction not in contact with ground and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.

E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

2.3 FIRE-RETARDANT TREATMENT

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with

the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664 and design value adjustment factors shall be calculated according to ASTM D6841.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

1. For exposed lumber indicated to receive a stained or natural finish, omit marking and provide certificates of treatment compliance issued by testing agency.

E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.

F. Application: Treat items indicated on Drawings, and the following:

1. Dormer framing.
2. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

A. Load-Bearing Partitions by Grade: Construction or No. 2 grade.

1. Species:

a. Hem-fir (north); NLGA.
b. Southern pine; SPIB.
c. Douglas fir-larch; WCLIB or WWPA.
d. Spruce-pine-fir; NLGA.

B. Ceiling Joists: Construction or No. 2 grade.

1. Species:

a. Hem-fir (north); NLGA.
b. Southern pine; SPIB.
c. Douglas fir-larch; WCLIB or WWPA.
d. Spruce-pine-fir; NLGA.

C. Joists, Rafters, and Other Framing by Grade: Select Structural or No. 1 grade.

1. Species:

   a. Hem-fir (north); NLGA.
   b. Southern pine; SPIB.
   c. Douglas fir-larch; WCLIB or WWPA.

D. Exposed Framing: Hand-select material for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.

1. Species and Grade:

   a. As indicated above for load-bearing construction of same type.

2.5 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

C. Concealed Boards: 19 percent maximum moisture content and of any species

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.6 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.7 LAMINATED STRAND LUMBER (LSL) PARAPET CAP

A. Laminated-Strand Lumber (LSL): Structural composite lumber made from wood flake strands with grain primarily parallel to member lengths, evaluated and monitored in accordance with ASTM D5456, and manufactured with exterior-type adhesive complying with ASTM D2559. This will be used for blocking of the parapet caps. Refer to 076200 Sheet Metal Flashing, Trim and Copings and 075423 TPO Roofing specifications for any manufacturer specifications and requirements for attachments to this method of blocking.

1. Basis of Design: Parapet Cap Engineered Framing System: StrandGuard TimberStrand LSL 1.30E Engineered Lumber by PreBuck Engineered Framing Systems. PreBuck, which is located at: 2555 28th St. SW; Wyoming, MI 49519; Tel: 616-309-6256; Email: request info at sales@prebuckproducts.com; Web:http://www.prebuckproducts.com.
   a. OR approved equal product and material meeting requirements below. Field cutting is the responsibility of the contractor per means and methods. The Basis of design system is prepared to meeth the thickness require and can manufacture the widths required:
2. Dimensions:
   a. Thickness: Actual 1.5” thickness, to match nominal wood 2x lumber that may be used in some parapet conditions.
   b. Width: Per wall section dimensions on drawings, cut to size in factory or in the field.
3. Allowable Stresses:
   a. Extreme Fiber Stress in Bending, Edgewise (Fb): **1900 psi (13.1 MPa)**
   b. Tensile Strength: 1075 psi.
   c. Shear Strength: 150 psi.
   d. Compression - Perpendicular to Grain: 670 psi.
   e. Specific Gravity: 0.50 into the face, 0.42 into the edge.
4. Moisture Protection: Zinc borate through complete cross section.

2.8 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

   1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

D. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

E. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

G. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).

I. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 INSTALLATION OF WOOD FURRING

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

3.4 INSTALLATION OF WALL AND PARTITION FRAMING

A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs. Fasten plates to supporting construction unless otherwise indicated.

1. For exterior walls, provide 2-by-4-inch nominal-size wood studs spaced 16 inches o.c. unless otherwise indicated.
2. Provide continuous horizontal blocking at midheight of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.

B. Construct corners and intersections with three or more studs.

C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.

3.5 INSTALLATION OF CEILING JOIST AND RAFTER FRAMING

A. Ceiling Joists: Install with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.

B. Rafters: Notch to fit exterior wall plates and use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.

1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against valley rafters.
2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against hip rafter.

C. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.6 PROTECTION

A. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00

SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. Section Includes:

1. Wall sheathing

2. Roof Sheathing Coverboard

B. Related Requirements:

1. Division 06 Section "Rough Carpentry" for plywood backing panels.
2. Division 07 Section "Air Barriers" for air barrier applied over wall sheathing.
3. Division 07 Section "TPO Roofing" for Den's Deck Roof Sheathing.

1.3 PREINSTALLATION MEETINGS Division 07 Section "Air Barriers

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier and water-resistant glass-mat gypsum sheathing requirements and installation, special details, transitions, mockups, air-leakage testing, protection, and work scheduling that covers air-barrier and water-resistant glass-mat gypsum sheathing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: From air-barrier and water-resistant glass-mat gypsum sheathing manufacturer, certifying compatibility of sheathing accessory materials with Project materials that connect to or that come in contact with the sheathing.

B. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.

C. Evaluation Reports: For the following, from ICC-ES:

1.6 QUALITY ASSURANCE

A. Mockups: Refer to Division 07 Section “Air Barriers”

B. Certified Wood: Provide an invoice including vendor's chain-of-custody number, product cost, and entity being invoiced.

C. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Refer to Division 07 Section “Air Barriers”

1.8 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WALL SHEATHING

A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

1. Type and Thickness: Regular, 5/8 inch thick.

2. Basis of Design: Dens Glass.

B. Exterior Grade Plywood

1. Type and Thickness: Pressure Treated, 5/8 inch thick. Pressure treated ½” thick

C. Plywood

1. Type and Thickness: Regular, 5/8 inch thick & ½" thick.

2.2 ROOF SHEATHING COVERBOARD

A. Glass-Mat Gypsum Roofing Coverboard: ASTM E84
   1. Type & Thickness: 1/2" thick
   2. Basis of Design: DensDeck by GAF or approved equal

2.3 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

B. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

   1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.
   2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C954.

2.4 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Refer to Division 7 Section "Air Barriers".

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

   1. NES NER-272 for power-driven fasteners.
   2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
   3. ICC-ES evaluation report for fastener.

D. Coordinate wall installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to wood framing with nails or screws.
2. Fasten gypsum sheathing to cold-formed metal framing with screws.
3. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
4. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.

3.3 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
3. Termination mastic has been applied on cut edges.
4. Strips and transition strips have been firmly adhered to substrate.
5. Compatible materials have been used.
6. Transitions at changes in direction and structural support at gaps have been provided.
7. Connections between assemblies (sheathing and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
8. All penetrations have been sealed.

B. Air barriers will be considered defective if they do not pass tests and inspections.

C. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

D. Prepare test and inspection reports.

END OF SECTION 06 16 00

SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. Section Includes:

1. Interior standing and running trim.
2. Shop finishing of interior woodwork.
3. Plastic-laminate cabinets.
4. Wood Paneling
5. Solid-surfacing-material countertops.
6. Stainless steel countertops and wall covering.
7. Closet Shelving.
8. Countertop Supports.
9. Metal Grommets
10. Wood and Acrylic Brochure Display.

B. Related Requirements:

1. Division 06 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing interior architectural woodwork that are concealed within other construction before interior architectural woodwork installation.
2. Division 09 Sections "Painting" and "Staining and Transparent Finishing" for field applied finishes.

1.3 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that interior architectural woodwork can be supported and installed as indicated.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site. For interior frames, discuss coordination with hardware and access control installers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for plumbing fixtures faucets soap dispensers and other items installed in architectural woodwork.
4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

C. Samples:

1. Lumber with or for transparent finish, not less than 50 sq. in. or 5 inches wide by 24 inches long, for each species and cut, finished on 1 side and 1 edge.
2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
3. Veneer-faced panel products with or for transparent finish, 8 by 10 inches, for each species and cut. Include at least one face-veneer seam and finish as specified.
4. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.
5. Solid-surfacing materials, 6 inches square.
6. Corner pieces as follows:
   a. Miter joints for standing trim.

7. Exposed cabinet hardware and accessories, one unit for each type and finish.

D. Product Certificates: For each type of product, signed by product manufacturer.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.7 QUALITY ASSURANCE

A. Millwork shall be manufactured in accordance with the AWI Standards in the grades hereinafter specified. In event of a dispute as to the quality grades, all parties will call upon an inspection under AWI’s inspection procedures and agree to abide by the decision of AWI.

B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Shop Certification: AWI's Quality Certification Program accredited participant.

C. Installer Qualifications: Fabricator of products.

D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups for each typical interior architectural woodwork.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Forest Certification: Provide wood products made from forests certified by an FSC-accredited certification body. All non-FSC wood in assemblies with FSC-certified wood shall meet the FSC Controlled Wood (CW) criteria.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Architectural Woodwork Standards, Section 2.

B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.

C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.9 FIELD CONDITIONS

A. Environmental Limitations with Humidity Control: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction and indicate measurements on Shop Drawings.

C. Established Dimensions: Where interior architectural woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.10 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species and Cut for Transparent Finish: White Maple, Flat-cut, Clear. Grade: Custom.

C. Wood Products: Comply with the following:
1. Hardboard: AHA A135.4.
2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
3. Particleboard: For all wood veneer panels in public spaces or egress corridors: Mat-formed wood particleboard, 45 pound density, complying with AWI 200-G-2. UL approved Class 1 fire retardant treated. ASTM E 84. Thickness: ¾". Flame Spread: 20. Representative Product: Duraflake FR by Weyerhaeuser.
4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.
5. Cleats: Veneer faced cleats at panel joints: ¾" Medium Density Fiberboard

D. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

2.2 ARCHITECTURAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain requirements that are more stringent than the Architectural Woodwork Standards. Comply with Contract Documents and Architectural Woodwork Standards.

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.

1. Grass America; G393.
2. Salice; Series 200.
3. Blum; Clip Top Press-In 71T6580

C. Concealed hinges:

1. Hafele America Co.; A-Form hinge, 45/9.5, opening angle 175 degrees, or approved equal.

D. Magnetic Pressure Catch and Push-in magnetic catches, BHMA A156.9, B03131:

1. Hafele America Co.; black plastic, screw-on, 245.60.307.
2. Cabinet Pulls: Provide the following Bar Pull or approved equal:
   a. Manufacturer: Amerock
   b. Finish: Brushed Stainless Steel
   c. Size: 5” x 3/8”
   d. Number: AME 08279

E. Catches: Roller catches, BHMA A156.9, B03071.

F. Drawer Locks: BHMA A156.11, E07041.

1. Knape and Vogt: 986 lock, or approved equal.
2. Timberline Lock, Ltd.: CB-280, or approved equal.

G. Grommets for Cable Passage through Countertops: 2 1/2-inch(51-mm) OD, Metal, grommets and matching brushed nickel caps with slot for wire passage.

1. Product: Subject to compliance with requirements, provide "PS series" by Doug Mockett & Company, Inc., or approved equal.

H. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Stainless Steel: BHMA 630.

I. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

1. Shelf Support: Hafele #282.04.711, 5mm steel nickel plated, or approved equal.
2. Wall Panel Clips: Monarch Z clips #MFSS, 304 stainless steel – Exterior Clips, or approved equal.
3. Wall Panel Clips: Monarch Z clips #MFTH-624, 6063-T6 aluminum – Interior Clips, or approved equal.
4. Sliding Cabinet Door: European Style Sliding Door Hardware and recessed metal tracks by Rockler, or approved equal.
5. Sliding Glass Doors: E-Z Glide Tracks – Aluminum, shoe, tracks, nylon rollers and pulls by Rockler, or approved equal.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

D. Metal strapping:
1. Provide over drywall substrate at panel joints.
2. Contractor's option to use Zip-It Wall Anchors.

E. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Wood Glues: 30 g/L.
2. Contact Adhesive: 250 g/L.

F. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.

1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

G. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

H. Concealed Countertop Supports:
1. Provide steel concealed brackets by A&M Hardware, Inc. or approved equal.
2. Size: Coordinate with vanity detail for required supporting arm depth.
3. Install bracket within stud wall construction along with wood blocking.

I. Coat Hooks:
1. Provide two-prong, chrome finish coat hooks by Maosifang or approved equal.

2.5 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom -grade interior woodwork complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch (19 mm) Thick or Less: 1/16 inch (1.5 mm).

2. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch (1.5 mm).

D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

F. Fill joints or seams between plastic laminate sheets with plastic seam filler.

G. Caulk inside joints of plastic laminate woodwork with colored caulk.

H. Install glass to comply with applicable requirements in Division 08 Section "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.6 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Grade: Custom.

B. Wood Species and Cut: White Maple, Flat-cut, clear.

C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

D. Assemble casings in plant except where limitations of access to place of installation require field assembly.

2.7 SHOP FINISHING

A. Grade: Provide finishes of same grades as items to be finished.

B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

C. General: Shop finish transparent-finished interior architectural woodwork at fabrication shop as specified in this Section. Refer to Division 09 painting Sections for finishing opaque-finished architectural woodwork.

D. General: Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to Division 09 painting Sections for finishing architectural woodwork not indicated to be shop finished.

E. Shop Priming: Shop apply the prime coat including back-priming, if any, for transparent-finished items specified to be field finished. Refer to Division 09 painting Sections for material and application requirements.

F. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Back-priming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require back-priming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.

G. Transparent Finish:

1. Grade: Premium.
2. AWI Finish System 5 (previously #TR-4) Conversion varnish.
3. Flame Spread: Class A, Class 1 finish fire rating.
4. Staining: Match approved sample for color.
5. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
6. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
7. Filled Finish for Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
   a. Apply wash-coat sealer after staining and before filling.
8. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

2.8 PANELING, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of flush wood paneling (wood-veneer wall surfacing) indicated for construction, finishes, installation, and other requirements.

2.9 WOOD PANELING

A. Grade: Custom.

B. Wood Species: White Oak

C. Profile: V Rib T375 (Basis of Design: Surfacing Solution Solid Wood Tambour)
1. 3/8” height by ¾” slat width.
   WD-1 Wood Panel
   Manufacturer: Surfacing Solutions
   Species: White Oak

Style:	V-Rib Slat Profile 375
Finish:	Custom stain selected by architect and matched
Installation:	Vertical orientation underside of the reception counter with matching trim above and below panel and above the 4” rubber base. Runs across wall to wall.
Location:	Lobby

D. Thickness: 3/8 inch.

E. Finish and Grade: Custom stain selected by architect and matched. Provide Class A flame

F. Exposed Panel Edges: Provide matching wood species and finish 1”x3” trim on top & bottom edge.

G. Panel Reveals: None

H. Mounting: Adhered to wall above wall base 4” AFF.

2.10 PLASTIC-LAMINATE CABINETS

A. Grade: Custom.

B. AWI Type of Cabinet Construction: Flush overlay.

C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: Grade HGS.
2. Vertical Surfaces: Grade HGS.
3. Edges: Grade HGS.

D. Materials for Semi-exposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
   a. For semi-exposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.

2. Drawer Sides and Backs: Thermoset decorative panels.
3. Drawer Bottoms: Thermoset decorative panels.

E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations.

G. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

H. Schedule of Plastic-Laminate Materials:

PLAM-1
Manufacturer: Wilsonart
Color: Huntington Maple
Number: 7929-38
Finish: Fine Velvet Finish
Installation: Casework w/SSM-1 Countertops
Location: 004.1 Kitchenette, 209 Breakroom, 009 Wellness Lounge, 228, 229, 230 Locker Rooms

PLAM-2
Manufacturer: Wilsonart
Color: Frosty White
Number: 1753-60
Finish: Matte Finish
Installation: Restroom Sink Supports/ Skirts
Location: 125, 126 Public, 215.1 Captain's, 112, 130, 222 Staff Restrooms, 111, 227 Wellness

PLAM-3
Manufacturer: Wilsonart
Color: Misted Zephyr
Number: 4843-60
Finish: Matte Finish
Installation: Casework w/SSM-4 Countertops
Location: Typical Casework in Holding areas, 100 Community Room, 128 Reception

2.11 SOLID-SURFACING-MATERIAL COUNTERTOPS

A. Grade: Custom.

B. Solid-Surfacing-Material Thickness: 3/4 inch.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

1. As indicated by manufacturer's designations.

D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

1. Fabricate tops with loose backsplashes for field application.

E. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

F. Schedule of Solid-Surfacing Materials:

SSM-1
Manufacturer: Corian
Color: Designer White
Installation: Counter tops
Location: 004.1 Kitchenette, 209 Breakroom, 009 Wellness Lounge, 228, 229, 230 Locker Rooms

SSM-2
Manufacturer: Wilsonart
Color: Peace Grey
Installation: Counter tops
Location: 112, 130, 222 Staff Restrooms, 111, 227 Wellness , typical window sills.

SSM-3
Manufacturer: Corian
Color: Venetia Cream Leathered
Installation: Counter tops
Location: 125, 126 Public, 215.1 Captain's Restrooms

SSM-4
Manufacturer: Corian
Color: Carbon Concrete
Installation: Counter tops
Location: Typical Casework, 100 Community Room

2.12 STAINLESS STEEL COUNTERTOPS

A. Stainless Steel Countertop
1. Description: Fabricate units of stainless steel, Type 304, 16 gauge thick.
2. Stainless Steel Sheet: ASTM A240/A240M, austenitic stainless steel, type as indicated.
3. Stainless Steel Finish: Directional satin finish, ASTM A480/A480M, No. 4.
4. Fabricate countertop in one piece, unless otherwise indicated.
5. Square edge 1 ½" height, front edge.
6. Countertop Ends: hemmed and seam welded to square front edge.
7. Integral stainless steel, see drawings for dimension, under counter sink in countertop where shown (Gun Cleaning Room)
8. Backsplash: (ref. drawings) H. x 3/4" D. square edge stainless steel integral with countertop, with seamed closed ends.
9. Backer: (2) layers of moisture-resistant MDF.
10. Location: Gun Cleaning Room Rm 116, Processing Area Rm 137, Intox Rm 139.

2.13 STAINLESS STEEL WALL

A. Stainless Steel Wall
1. Description: Fabricate units of stainless steel, Type 304, 16 gauge thick.
2. Stainless Steel Sheet: ASTM A240/A240M, austenitic stainless steel, type as indicated.
3. Stainless Steel Finish: Directional satin finish, ASTM A480/A480M, No. 4.
4. Fabricate wall panel in one piece, unless otherwise indicated.
5. Rounded edge 1 ½" height, front edge.
6. Panel Ends: hemmed and seam welded to square front edge.
7. Location: Processing Area Rm 137 wall mounted behind cuff benches.

2.14 CLOSET WIRE MOULD SHELVING

A. Product: Wire shelving, by Closet Maid; SR shelf, or approved equal.

B. Shelf Material: Vinyl coated steel

C. Size: 12 inch deep x 2 inch height, unless noted below. Provide for width of the closet back wall.

D. Color: White

E. Hardware: Support brackets, side wall clips, closet rod end caps, wall clips #12 wall anchors and #12 x2 inch pan head screws.

F. Mounting: Surface wall mounted.

G. Miscellaneous Material: Provide solid wood blocking behind wall brackets.

H. Locations:
1. CLOSET RM 207.1 – Provide one shelf with hanger rod
2. CLOSET RM 209.1 – Provide three shelves. 18” deep.
3. CLOSET RM 217.1 – Provide one shelf with hanger rod.
4. CLOSET RM 217.2 – Provide three shelves. 18” deep.

2.15 ADJUSTABLE WALL SHELVING: CLOSET ADJUSTABLE BRACKET SHELVING SYSTEM

A. Product: Heavy-Duty Single Slot Flanged Bracket System with PLAM Shelves.
1. Basis of Design: Knape & Voigt 183 Series Flanged Bracker System
a. Or approved equal.

B. Shelf Material: PLAM-1 ON MDF PANEL CUT TO SIZE

C. Size: 16 inch deep. Provide for width of the closet back wall.

D. Color: Anochrome brackets

E. Adjustable: Vertically Adjustable to in 1” increments.

F. Mounting: Surface wall mounted.

G. Miscellaneous Material: Provide solid wood blocking behind wall brackets.

H. Locations:

Stor. Rm 224.1

2.16 WALL SHELVING & ROD: COAT HANGER AND ROD

A. Product: Heavy-Duty Single Slot Flanged Bracket System with PLAM Shelves.
1. Basis of Design: Knape & Voigt 1195 Series Commercial Heavy-duty Closet rod and shelf bracket, with Closet-Pro HD RP0020 Adjustable Closet Rod, Chrome & 12 qty 2038 Series commercial garment hooks.
a. Or approved equal.

B. Shelf Material: PLAM-1 ON MDF PANEL CUT TO SIZE

C. Size: 12 inch deep. Provide for width of the closet back wall.

D. Color: Chrome brackets

E. Adjustable: Vertically Adjustable to in 1” increments.

F. Mounting: Surface wall mounted.

G. Miscellaneous Material: Provide solid wood blocking behind wall brackets.

H. Locations:

2.17 WOOD AND ACRYLIC BROCHURE DISPLAY

A. Product: Heavy-Duty Single Slot Flanged Bracket System with PLAM Shelves.
1. Basis of Design: Knape & Voigt 1195 Series Commercial Heavy-duty Closet rod and shelf bracket, with Closet-Pro HD RP0020 Adjustable Closet Rod, Chrome & 12 qty 2038 Series commercial garment hooks.
a. Or approved equal.

B. Shelf Material: PLAM-1 ON MDF PANEL CUT TO SIZE

C. Size: 12 inch deep. Provide for width of the closet back wall.

D. Color: Chrome brackets

E. Adjustable: Vertically Adjustable to in 1” increments.

F. Mounting: Surface wall mounted.

G. Miscellaneous Material: Provide solid wood blocking behind wall brackets.

H. Locations:

Dress. Rm 216.2

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.2 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

G. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 96-inches (2400 mm) long, except where shorter single-length pieces are necessary.

1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
2. Install wall railings on indicated metal brackets securely fastened to wall framing.
3. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

H. Paneling: Anchor paneling to supporting substrate with concealed panel-hanger clips. Do not use face fastening, unless covered by trim.

1. Install flush paneling with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.

I. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish, for wood cabinets.
3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches(400 mm) o.c. with No. 10 wafer-head screws sized for 1-inch(25-mm) penetration into wood framing, blocking, or hanging strips .

J. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Align adjacent solid-surfacing material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
3. Secure backsplashes to tops with concealed metal brackets at 16 inches(400 mm) o.c. and to walls with adhesive.
4. Seal seams between plastic laminate panels and between top and backsplash with plastic seam filler.
5. Caulk space between backsplash and wall with colored caulk.

K. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06 40 23

SECTION 07 05 43 - RAIN SCREEN ATTACHMENT SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

C. Provide a non-continuous, aluminum rain screen attachment system for attachment of various siding types, installed in conjunction with exterior insulation. System shall be designed to incorporate flashing components, drainage components, and air barriers in such a way that the system will properly perform.

1.2 RELATED SECTIONS

A. Division 01 Section "Mockups" for integrated exterior mockup requirements.
B. Section 05 40 00 – Cold-Formed Metal Framing
C. Section 06 10 00 – Rough Carpentry
D. Section 06 16 00 – Sheathing
E. Section 07 21 00 – Thermal Insulation
F. Section 07 27 00 – Air Barriers
G. Section 07 42 13.23 – Formed Metal Wall Panels
H. Section 07 62 00 – Sheet Metal Flashing and Trim

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM) Publications:

1. ASTM E330 – Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
2. ASTM E331 – Test Method for Water Penetration of Exterior Windows

B. American Society of Civil Engineers (ASCE) Publications:

1. ASCE 7 – Minimum Design Loads for Buildings and Other Structures

C. IBC 1403.2: Reference Standard for Selection of Weather Resistive Barriers

D. AAMA 509: Test and Classification Method for Drained and Back-Ventilated Rain Screen Wall Cladding Systems

1.3 SYSTEM DESCRIPTION

A. System assembly shall include the following components:

1. Substrate: Wall framing assembly with sheathing or Mass backup wall
2. Weather Resistant/Air Barrier over substrate
3. Exterior Insulation
4. Non-continuous aluminum rain screen attachment system
5. Exterior cladding

B. Design Requirements

1. Provide, in conjunction with wall substrate and air barrier, a weather tight wall assembly utilizing rain screen principle.
2. Manufacturer is responsible for designing the rainscreen attachment system, including anchorage to structural components.
3. Design modifications shall be provided only as necessary to satisfy as built conditions and to meet performance requirements.
4. Employ registered professional engineer, licensed to practice engineering in Maryland, to engineer each component of rain screen attachment system.

1.4 PERFORMANCE REQUIREMENTS

A. Thermal Performance

1. Attachment system must be thermally modeled to demonstrate, at minimum, a compliance with ANSI/ASHRAE 90.1-2010 maximum U-Value for walls
2. Continuous framing profiles (including C- or Z-shaped sections or furring) penetrating insulation are not permitted

B. Design Loads: Per structural drawings, to be confirmed in Shop drawings. Stamped calculations are required in final submittal once subframing design is complete.

1. System shall be optimized based on design loads of cladding specified.
2. Maximum panel deflection: 1/175 of span or less of span when tested in accordance with positive and negative pressures and as required to prevent cracking or damage to panel facing
3. Adequately resist wind forces and uplift for Project location as per Cladding pressure table on structural sheet S-011 when tested in accordance with ASTM E330.
4. Accommodate movement of cladding components without undue stress on fasteners or other detrimental effects, when subjected to seasonal temperature range of :
    a. Ambient: 120 degrees F
    b. Cladding surface: 180 degrees F
5. Accommodate tolerances of support structure
6. Condensation: System shall accommodate positive drainage for moisture entering or condensation occurring within panel system.
7. Flatness: System shall be flat with no noticeable warpage, buckling, deflections or other surface irregularities

1.5 SUBMITTALS

A. Product data information describing materials and fabrication for aluminum rain screen attachment system.

B. Shop Drawings: Submit detailed shop drawings for subframing showing:

1. Location, layout, and dimensions of panels, including special pieces and trim. If panel shops by cladding suppliers, they must be provided to subframing company to allow for subframing shops providing a complete integrated set with both panel and subframing layout.
2. Locations of fixed and sliding fastening points
3. Details at top, bottom, corner, windows, doors, etc.
4. Installation details: attachment methods, fasteners, joints, corners, openings, intersections with adjacent materials, flashings, closures, trim and other critical conditions

C. Copy of written approval by perimeter fastener supplier of the use of selected screws confirming use in a rainscreen wall assembly.

D. Engineering Calculations: Submit engineering calculations as required by local building code. Certified Engineering is to be delegated design by the contractor and submitted to architect for record only.

E. Samples

1. 3 inches minimum length for each attachment profile used
2. Typical anchor brackets and fasteners, one of each type used

F. Provide manufacturer’s sample minimum 2 year warranty, installation and maintenance instructions

1.6 MOCKUPS Include Wall Panel, Soffit Panel, & Linear Ceiling with attachments and recessed soffit light fixture trim (electrical not required) integrated exterior mockup that will be used to demonstrate aesthetic effects, perform preconstruction testing, and to set quality standards for materials and installation. See Division 01 Section "Mockups" for additional construction requirements. Provide shop drawing to be coordinated with mockup layout.

1.7 QUALITY ASSURANCE

A. System Manufacturer’s Qualifications: Provide exterior wall system manufactured by a firm with minimum 15 years’ experience in the production of systems that are similar to those indicated for this project
B. Installer Qualifications: Company experienced in installing rain screen systems and acceptable to Rain Screen Attachment System supplier.
C. Attachment details shall be designed under direct supervision of licensed professional structural engineer. Calculations and shop drawings shall bear seal of supervising engineer.

1.8 QUALITY CONTROL

A. Single Source Responsibility: Furnish engineered rain screen attachment system components under direct responsibility of single manufacturer

B. Field Measurements: Verify actual supporting and adjoining construction before fabrication. Record measurements on project record shop drawings.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Prior to shipping, pack and crate system components to prevent damage during transit and storage.
B. Deliver materials and components in manufacturer's original, unopened, and undamaged containers or bundles, fully identified. Exercise care to avoid damage during unloading, storing and installation.
C. Inspect aluminum attachment components immediately upon delivery at site. Notify manufacturer of damage.
D. Follow manufacturer's instruction for storage of product. Keep pieces in original packing material until ready to install.

1.10 WARRANTY

A. Two Year Warranty: Provide manufacturer's written warranty for aluminum rain screen attachment system to cover repair and replacement of defective components

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Basis of Design for tapered panels: For Vertical applications of subframing attachment, provide Aluminum Rain Screen Attachment System with non-continuous, self-shimming bracket and rail assembly to accommodate out of plumb conditions, nominal system depth: 7" from face of substrate:
    1. "ECO Cladding: Alpha Vci.150"
    2. Or equivalent product by approved equal manufacturer
B. Basis of Design for Morin panels: For Horizontal applications of subframing attachment, provide Aluminum Rain Screen Attachment System with non-continuous, self-shimming bracket and rail assembly to accommodate out of plumb conditions, nominal system depth: 3 ½" from face of substrate:
    1. "ECO Cladding: Alpha Hci.080"
    2. Or equivalent product by approved equal manufacturer

2.2 PRODUCT REQUIREMENTS

A. Provide all rain screen attachment system components from a single source compatible with the following assemblies and covering all conditions per the wall sections.
    1. Metal Panel Rain Screen Profiles with Wall Assembly:
       Metal Panel System over Insulated 6" MTL STUD –
       EXTERIOR WALL ASSEMBLY:
       Concealed Fastner Metal Panel system over attachment sub-framing (includes air space) Morin Pulse & Matrix (basis of design)
       3-1/2" SEMI-RIGID INSUL.
       AIR/WATER-RESISTIVE BARRIER

5/8" GYPSUM SHEATHING
6" MTL STUDS @ 16" O.C. W/ 6" BATT INSUL.
Interior finish as detailed

2. Metal Panel Rain Screen Profiles with Wall Assembly @ Mechanical Well:
   Metal Panel System over Insulated 8" CMU Block –
   EXTERIOR WALL ASSEMBLY:
   Concealed Fastner Metal Panel system attached to sheathing (includes air space) Morin Pulse & Matrix (basis of design)
   5/8" Sheathing as detailed
   6"CFM Stud hung outboard by w/ 3-1/2" SEMI-RIGID INSUL. between
   AIR/WATER-RESISTIVE BARRIER
   8" CMU
   Interior finish as detailed

B. Materials

1. Bracket and rail components
   a. Made from 6000 series architectural grade aluminum
   b. Finish: Mill finish
   c. Brackets shall be self-shimming for out of plumb conditions, with at least 1" of built in adjustability
2. Fasteners
   a. Minimum 304 series stainless steel fasteners and anchors of type, size and spacing required for type of substrate and Project conditions, to meet performance requirements specified in Paragraph 1.4 and as indicated in design calculations and shop drawings.
3. The following characteristics are <u>not</u> acceptable:
   a. Continuous framing profiles (including C- or Z-shaped sections or furring) completely penetrating insulation
   b. Components made from galvanized steel, galvalume, or other carbon based metals
   c. Components made from FRP or fiberglass materials

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of rainscreen cladding

B. Do not proceed with cladding installation until deficiencies have been addressed

3.2 RAIN SCREEN ATTACHMENT SYSTEM INSTALLATION

A. Install rain screen attachment system in accordance with manufacturer's instructions and approved shop drawings

B. Establish level lines for panel coursing and positioning of support brackets and support rail.

C. Attach brackets with engineered fasteners to accomplish performance requirements specified in Paragraph 1.4

D. Attach vertical or horizontal support rails with engineered fasteners to accomplish performance requirements specified in Paragraph 1.4

a. Provide 1/2"- 1" (12 to 25mm) space between end of adjacent profiles

E. Install exterior insulation to fit between wall brackets as specified in Section 07 21 00.

3.3 QUALITY CONTROL

A. The installing contractor shall perform daily inspections to maintain and confirm that tolerances are being met and that manufacturer's instructions are complied for review of a third party inspection agency.

3.4 CLEANING AND PROTECTION

A. Remove and replace damaged, bowed, or bent pieces of aluminum

B. Immediately after installing, wipe down work. Do not use wire brushes, metallic tools, or abrasives for cleaning.

C. Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities

END OF SECTION 07 05 43

SECTION 07 13 26 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management’s general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.1 SUMMARY

A. Section Includes:

1. Modified bituminous sheet waterproofing.
2. Molded-sheet drainage panels.

B. Related Requirements:

1. Division 7 Section “Thermal Insulation” for insulation.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturers.

B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.

1. Build for each typical waterproofing installation including accessories to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, and protection.

a. Size: Per Mockup Panel.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.7 WARRANTY

A. Manufacturer's Warranty:

1. Waterproofing Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

a. Warranty Period: **5** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Waterproofing System: Obtain waterproofing materials, protection course, and molded-sheet drainage panels from single source from single manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Modified Bituminous Sheet Waterproofing: Minimum 60-mil (nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil-thick, polyethylene-film reinforcement, and with release liner on adhesive side.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. GCP Applied Technologies (formerly W.R. Grace); Bituthene 4000.
b. Henry Company; Blueskin WP 100/200.
c. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRI 860/861.
d. Meadows, W. R., Inc.; SealTight Mel-Rol.

2. Physical Properties:

a. Tensile Strength, Membrane: 250 psi minimum; ASTM D412, Die C, modified.
b. Ultimate Elongation: 300 percent minimum; ASTM D412, Die C, modified.
c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D1970/D1970M.
d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C836/C836M.
e. Puncture Resistance: 40 lbf minimum; ASTM E154/E154M.
f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D570.
g. Water Vapor Permeance: 0.05 perm maximum; ASTM E96/E96M, Water Method.
h. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D5385.

3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.3 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid primer recommended for substrate by sheet waterproofing material manufacturer.

C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet waterproofing material manufacturer.

D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.

E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

F. Metal Termination Bars: Type 304 Stainless stee bars, approximately 1 by 1/8 inch, predrilled at 9-inch centers.

2.4 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel without Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of the core, without a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Grace, W. R., & Co. - Conn.; Hydroduct 220.
   b. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRAIN 6000,CCW MiraDRAIN 6000XL, CCW MiraDRAIN 6200 or CCW MiraDRAIN 6200XL.

2.5 INSULATION

A. Insulation: Comply with Division 07 Section "Thermal Insulation" for below grade insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of waterproofing.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D4263.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing applications.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections.

E. Fill form tie holes, honeycomb, aggregate pockets, holes, and other voids.

F. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D4258.

G. Bridge and cover isolation joints, expansion joints, and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.

H. Corners: Prepare, prime, and treat inside and outside corners in accordance with manufacturer's instructions.

I. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions.

3.3 INSTALLATION OF MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.

D. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.

E. Seal edges of sheet waterproofing terminations with mastic.

F. Install sheet waterproofing and auxiliary materials to tie into adjacent waterproofing.

G. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.

H. Immediately install drainage panels over waterproofing membrane.

3.4 INSTALLATION OF MOLDED-SHEET DRAINAGE PANELS

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install board insulation after installing drainage panels.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components; and to furnish daily reports to Architect.

3.6 PROTECTION, REPAIR, AND CLEANING

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Protect installed insulation and drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 07 13 26

SECTION 07 21 00 – THERMAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.1 SUMMARY

A. Section Includes:
1. Mineral-wool blanket insulation & Semi-Ridged Insulation Board.
2. Extruded-Polystyrene (XPS) Board Insulation for below grade.
3. Spray polyurethane foam insulation.

B. Related Sections:
1. Division 07 Section "TPO Roofing" for insulation specified as part of roofing construction.
2. Division 07 Section "Vapor Retarders".
3. Division 07 Section "Fire-Resistive Joint Systems" for insulation installed as part of a perimeter fire-resistive joint system.
4. Division 06 Section "Sheathing"

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene (XPS) Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Owens Corning; Foamular NGX Thermapink XPS (Basis of Design).
   b. Dupont: Styrofoam Cavitymate Ultra
   c. Or approved equal

2. Compressive Strength:

   a. Horizontal applications: Minimum 40-psi (Type XIV).
   b. Vertical Applications: Minimum 25-psi (Type IV).

3. Thickness: 3-inch as shown on details
4. Thermal Resistance: R-15 minimum. Meet R-Values per drawings.
5. Size: 48 by 96 inches.
6. Edge: Shiplap.
7. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84 - Class A.
8. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
9. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.2 MINERAL-WOOL BATT INSULATION

A. Mineral-Wool Batt Insulation, Unfaced: ASTM C665, Type I (batts without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Rockwool.; Comfortbatt.
   b. Owens Corning; Thermafiber UltraBatt
   c. Johns Manville; TempControl.

2. Thickness: 6-inch.
3. R-Value: R-14.

4. Facing: Unfaced
5. Flame-Spread Index: Not more than 5 when tested in accordance with ASTM E84.
6. Smoke-Developed Index: Not more than 5 when tested in accordance with ASTM E84.
7. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.3 MINERAL-WOOL SEMI-RIGID BOARD INSULATION

A. Mineral-Wool Board Insulation, Unfaced: ASTM C612, Type IVB; passing ASTM E136 for combustion characteristics.

1. Products:Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Rockwool.; Comfortboard 80 (#329356) Basis of Design.

   b. Owens Corning; Thermafiber RainBarrier CI High Compressive 80
   c. Johns Manville; Cladstone 80.

2. Thickness: 3-1/2-inch.
3. R-value: R-14 minimum.
4. Facing: Unfaced.
5. Nominal Density: 6 lb/cu. ft.
6. Moisture-Resistance: Absorption of less than 0.03% by volume when tested in accordance with ASTM C1104.
7. Flame-Spread Index: Not more than zero when tested in accordance with ASTM E84.
8. Smoke-Developed Index: Not more than zero when tested in accordance with ASTM E84.
9. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

B. Mineral-Wool Board Insulation, with painted ½" glass mat gypsum coverboard see Division 06 Section "Sheathing" for coverboard. Use specified Mineral-Wool Board Insulation above.

2.4 MINERAL-WOOL BLANKET INSULATION (Acoustic)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fibrex Insulations Inc.
2. Owens Corning.
3. Roxul Inc.
4. Thermafiber.

B. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.5 SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84 for insulating around penetrations in exterior walls.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Corporation.
b. BaySystems NorthAmerica, LLC.
c. Dow Chemical Company (The).
d. ERSystems, Inc.
e. Gaco Western Inc.
f. Henry Company.
g. NCFI; Division of Barnhardt Mfg. Co.
h. SWD Urethane Company.
i. Volatile Free, Inc.

2. Minimum density of 1.5 lb/cu. ft. (24 kg/cu. m), thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F (43 K x m/W at 24 deg C).

2.6 INSULATION FASTENERS

A. Fasteners: Manufacturer’s standard for attachment to approved substrate.

2.7 ACCESSORIES

A. General: As recommended by manufacturer for intended use and compatibility with other components.

B. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF XPS BOARD INSULATION ON BELOW GRADE WALLS

A. Butt panels together for tight fit.

B. Install board insulation after installing drainage panels.

C. Adhesive Installation: Install with adhesive according to manufacturer's written instructions.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

3.5 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:

    a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

5. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings and seal each continuous area of insulation to ensure airtight installation.

    a. Exterior Walls: Set units with facing placed toward interior of construction.

D. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.6 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION

A. Where insulation blankets are indicated for sound attenuation above ceilings, install blanket insulation over entire ceiling area in thicknesses indicated.

3.7 PROTECTION

A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 27 00 - AIR BARRIERS

PART 1 - GENERAL

1.0 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.1 SUMMARY

A. Section Includes:

1. Vapor-permeable, fluid-applied air barriers.

B. Related Requirements:
1. Division 01 Section “Mockups”
2. Division 06 Section "Sheathing" for glass-mat gypsum wall sheathing.

1.2 DEFINITIONS

A. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

B. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

C. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of sheathing, air barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for sheathing joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: From air-barrier and water-resistant glass-mat gypsum sheathing manufacturer, certifying compatibility of sheathing accessory materials with Project materials that connect to or that come in contact with the sheathing.

B. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

B. Integrated Mockup: Build mockup to set quality standards for materials and execution and for preconstruction testing.
1. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Contractor will engage a qualified testing agency to perform preconstruction testing on field mockups.

B. Mockup Testing: Air-barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1. Air-Leakage-Location Testing: Integrated Mockup will be tested for evidence of air leakage according to ASTM E1186, chamber pressurization or depressurization with smoke tracers or ASTM E1186, chamber depressurization with detection liquids.
2. Adhesion Testing: Integrated Mockup will be tested for required air-barrier adhesion to substrate according to ASTM D4541.
3. Notify Architect seven days in advance of the dates and times when mockups will be tested.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.10 WARRANTY

A. Manufacturer's Single Source Warranty: Manufacturer must warrant the material against product defect for a period of ten (10) years from date of purchase.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E2357.

2.3 FLUID-APPLIED VAPOR PERMEABLE MEMBRANE AIR BARRIER,

A. High-Build, Vapor-Permeable Air Barrier: synthetic polymer membrane with an installed dry film thickness, in accordance with manufacturer's written instructions, of 35 mils or thicker over smooth, void-free substrates.

1. Synthetic Polymer Standard Type: 40 deg F and higher.

a. Basis-of-Design Product: Subject to compliance with requirements, provide Henry Company 'Air-Bloc 17 MR' or comparable product by one of the following:

1) GCP Applied Technologies Inc. (formerly Grace Construction Products); Perm-a-Barrier VPL
2) Carlisle Coatings & Waterproofing, Inc.; Fire Resist Barritech VP

2. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
b. Vapor Permeance: Minimum 5 perms; ASTM E 96/E 96M, Water Method, Procedure B.
c. Vapor Permeance: Record value from manufacturer; ASTM E 96/E 96M, Desiccant Method, Procedure A.
d. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
e. Adhesion to Substrate: Minimum 16 lbf/sq. in. when tested in accordance with ASTM D 4541.
f. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
g. UV Resistance: Can be exposed to sunlight for 90 days in accordance with manufacturer's written instructions.

2.4 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.

1. Basis of design: Henry® Blueskin® Adhesive

a. Color: Blue
b. Maximum VOC: 450 g/L
c. Drying time (initial set): 30 minutes
d. Low Application Temperature: 10 degrees F (-12 degrees C)

C. Liquid-Applied Flashing: Moisture-curing single component elastomeric liquid-applied flashing using a highly advanced Silyl-Terminated Polyether (STPE) polymer curing to a monolithic membrane; having the following typical physical properties:

1. Basis of design: Henry® Air-Bloc® LF Liquid-Applied Flashing

a. Color: Blue
b. Air Permeance (ASTM E2178): Pass
c. Water Vapor Permeance (ASTM E96): 21.8 perms @ 25 mils
d. Air Leakage of Air Barrier Assemblies (ASTM E2357): Pass
e. Water Resistance (AC212/ASTM D2247): Pass

f. Nail Sealability (AAMA 711): Pass
g. Surface Burning Characteristics (ASTM E84):

1) Flame Spread: Class A
2) Smoke Development: Class A

h. Elongation (D412): 264%
i. Low Application Temperature: 20 degrees F (-7 degrees C)

D. Self-Adhered Vapor Permeable Flashing: Self-adhered water resistive vapor permeable air barrier consisting of a reinforced modified polyolefin tri-laminate film surface and patented adhesive technology with split-back poly-release film; having the following typical physical properties:

1. Basis of design: Henry® Blueskin® VP160 Self-Adhered Water Resistive Air Barrier

a. Color: Blue
b. Thickness: 23 mils (0.58 mm)
c. Water Vapor Permeance (ASTM E96): 29 perms
d. Nail Sealability (ASTM D1970): Pass
e. Low Application Temperature: 20 degrees F (-7 degrees C)

E. Building Envelope Sealant: Moisture cure, medium modulus polymer modified sealing compound; having the following typical physical properties:

1. Basis of design: Henry® 925 BES Sealant

a. Color: Varies
b. Elongation: 450 – 550%.

F. Termination Sealant: One-part high performance synthetic rubber sealant; having the following typical physical properties:

1. Basis of design: Henry® 212 All Purpose Crystal Clear Sealant

a. Color: Clear
b. Elongation: 200% minimum

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
3. Verify that substrates are visibly dry and free of moisture.
4. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

H. Bridge joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.3 ACCESSORIES INSTALLATION

A. Install accessory materials in accordance with air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply **transition strip** so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.

F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

H. Seal top of through-wall flashings to air barrier with an additional 6-inch- (150-mm-) wide, transition strip.

I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counter flashings or ending in reglets with termination mastic.

J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION

A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier in accordance with air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.

1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.

B. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates in accordance with the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.

1. Vapor-Permeable, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 35 mils, applied in one or more equal coats.

C. Do not cover air barrier until it has been tested and inspected by testing agency.

D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.5 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Air-barrier dry film thickness.
3. Continuous structural support of air-barrier system has been provided.
4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
5. Site conditions for application temperature and dryness of substrates have been maintained.
6. Maximum exposure time of materials to UV deterioration has not been exceeded.
7. Surfaces have been primed.
8. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
9. Termination mastic has been applied on cut edges.
10. Air barrier has been firmly adhered to substrate.
11. Compatible materials have been used.
12. Transitions at changes in direction and structural support at gaps have been provided.
13. Connections between assemblies (air barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
14. All penetrations have been sealed.

C. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

D. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

E. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than

recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.

2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 07 27 00

SECTION 07 42 13 – FORMED METAL WALL PANELS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.1 SUMMARY

A. Section Includes:

1. Formed Metal Wall Panels Concealed-fastener, lap-seam metal profiled wall panels, solid.
2. Formed Metal Soffit Panels, see 07 42 93 - EXTERIOR SOFFIT PANELS

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. not used.

C. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).

D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.

1. Include Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:

1. Formed Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

F. Integrated Mockup: Refer to Section 01 43 39. Include up to four varieties of three different colors, to be tested in the mockup for approval of final color of panels. Include Wall Panel with attachments and recessed soffit light fixture trim (electrical not required) integrated exterior mockup that will be used to demonstrate aesthetic effects, perform preconstruction testing, and to set quality standards for materials and installation. See Division 01 Section "Mockups" for additional construction requirements. Provide shop drawings to be coordinated with mockup layout.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Installer certified by the manufacturer and the work to be supervised by a person having successfully completed a manufacturer training program regarding proper installation of the specified product.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items in manufacturer’s original, unopened, undamaged packaging with identification labels intact so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Store wall panel materials on dry, level, firm and clean surface. Elevate one end of bundle to allow moisture run-off, cover and ventilate to allow air to circulate and moisture to escape. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.7 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.8 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factoryapplied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214, Method A.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion or 20 years and 3 months from the date of shipment from manufacturer’s plant, whichever occurs first.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330/E 330M:

1. Wind Loads: As indicated on Drawings.
2. Deflection Limits: For wind loads, no greater than 1/240 of the span.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F.

C. Water Penetration under Static Pressure: Provide metal wall panel systems designed to resist penetration of water under static pressure. Testing shall be based on ASTM E331. Wall panels when tested shall have no water leakage at 6 pounds per square foot.

D. Air Infiltration: Provide metal wall panel assemblies designed to resist air infiltration. Testing shall be done based on ASTM E283. Wall panels when tested shall have a maximum air leakage of 0.01 cfm per square feet of fixed wall area at a minimum static air-pressure differential of 1.57 foot pounds per square foot.

2.2 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

A. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners inside laps. Include accessories required for weathertight installation.

B. Concealed-Fastener Metal Wall Panels.

1. Basis-of-Design Product: Subject to compliance with requirements, provide ‘Concealed Fastener Wall Series’ by Morin; a Kingspan Group Company or approved equal product.

2. Aluminum Sheet: Coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness**:** 0.040 inch

3. Description:

a. Panel Width: 12 inches.
b. Profiles: Basis of Design: Pulse-1 (Profile-1), Pulse-3 (Profile-1) and Matrix-10 (Profile-3).

1) A mix of (3) profiles will be used.
2) Locations: Refer to Drawings.

c. Panel thickness: 1 1/2-inch thick profile plus ½” attachment gap.
d. Panel joint: Tongue and groove interlock joint.
e. Texture: Smooth

f. Colors: As selected by Architect from manufacturer’s premium paint metallic color selections.
g. Basis of Design Colors:

1) Profile-1 is to be light gray: “Silversmith” Premium Paint
2) Profile-2 is to be dark gray: “Pewter” Premium Paint
3) Profile-3 is to be a wood-look woodgrain print patterns
   i Basis of Design: OCM Timbermet or equal approved finishings system
4) A mix of up to (2) colors will be used on wing A, and the (1) color printed wood look is to be used at the soffit, canopy fascia, and wall panel at entrance, see drawings.
5) Locations: Refer to Drawings.

h. Exterior Finish: Premium Metallic, three coat fluoropolymer.
1) Basis of Design Product: 1.5 mil. Fluropolymer (PVDF) Three Coat system: 0.2 mil primer with 0.8 mil Kynar 500 (70%) METALLIC color coat and .5 mil clear coat.

2.3 NOT USED

2.4 ACCESSORIES

A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated. Accessories shall be as indicated on approved shop drawings and per manufacturer’s approved standard details.

1. Metal Profile Closure Strips: Shall be fabricated from same gauge, material and finish as metal panel.
2. Coping for tapered panels: integrated coping in depth to match maximum depth of taper, attached to last horizontal panel joint per architectural detail.
3. Mitered Corners: Structurally bonded horizontal outside or inside trimless corners matching metal wall panel material, profile and factory applied finish fabricated by metal wall panel manufacturer.
   a. Welded, riveted or field fabricated corners are not acceptable.

B. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

C. Metal Framing for tapered panels:

1. General: ASTM C645, cold-formed metallic-coated steel sheet, ASTM A653, G40 hot-dip galvanized. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
2. Hat-Shaped horizontal Furring Channels:
   a. Nominal Thickness and depth per engineered shop drawings.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads.

E. Panel Sealant:

1. Joint Sealant: ASTM C920 as recommended in writing by metal wall panel manufacturer.
2. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.5 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flatlock seams. Tin edges to be seamed, form seams, and solder.
3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.6 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation. C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.

6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:
1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Flash and seal panels with weather closures at perimeter of all openings.

E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar

items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 13

SECTION 07 42 93 – EXTERIOR SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

C. Section Includes:

1. Metal exterior soffit panel, linear metal ceiling panel, fascia, formed metal wall panel.

2. See also SECTION 07 42 13 – FORMED METAL WALL PANELS.

1.2 RELATED SECTIONS

A. Division 01 Section "Mockups" for integrated exterior mockup requirements.

B. Section 05 40 00 - Cold-Formed Metal Framing: Metal framing for support of aluminum soffits.

C. Section 07 62 00 - Sheet Metal Flashing and Trim

D. Section 07 90 00 - Joint Sealers

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Include trim and layout of square recessed light fixtures, GC to coordinate with electrical subcontractor.

C. Samples: Submit duplicate 1.625 X 4 inch X 6 inch (41.28mm X 101.6mm X 150mm) samples of material, of color and profile specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 MOCKUPS

A. Include Wall Panel, Soffit Panel, & Linear Ceiling with attachments and recessed soffit light fixture trim (electrical not required) integrated exterior mockup that will be used to demonstrate aesthetic effects, perform preconstruction testing, and to set quality standards for materials and installation. See Division 01 Section "Mockups" for additional construction requirements. Provide shop drawing to be coordinated with mockup layout.

1.7 WARRANTY

A. Provide a written guarantee, signed and issued in the name of the owner, covering the metal cladding/siding material for 15 (fifteen) years from the date of Substantial Completion. Verify available warranties and warranty periods for metal panels.

1. Warranty Period: 15 (fifteen) years from date of Substantial Completion.

B. The manufacturer's warranty is limited to replacement of defective material only, rather than installation of the same. Faulty installation shall be corrected by the installing contractor. The warranty required herein is the sole remedy against the manufacturer and there are no other implied warranties. In any event, the manufacturer shall not be liable for incidentals or consequential damages.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. NOTE: the same metal panel system is to be used for wood look wall panels, wood look soffits, wood look ceilings in the vestibule and wood look fascia. Equals need to vertical joints to be coordinated by the GC where this wood look system meets the Formed Metal Panels and their attachment systems.

B. See section 07 42 13 Formed Metal Wall Panels

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Basis of Design – Morin by Kingspan, Matrix MX10 with wood-look metal panel.
Morin Martix Series
a. Finish from the OCM custom wood grain finishes line, selected by architect.
b. Michael Moorhouse | CSI, LEED AP Partner + Design Consultant | Rainscreen Experto. (202) 869-3445 | m. (410) 422-6453
2. Long Board - Mayne Inc. 27575 50Ave Langley, BC Canada V3A 0A2 em. info@longboardproducts.com
ph. 1.800.604.0343
3. Knotwood - Alumarch.com, 30 Technology Pkwy S, Peachtree Corners, GA 30092

https://knotwood.com/

4. Or approved equal.

2.2 PERFORMANCE REQUIREMENTS

A. ALUMINUM CLADDING AND COMPONENTS
1. 625 X 4 inch Beam (41.28mm X 101.6mm) extruded aluminum 6063 T5
2. Finish coating: powder coated finish
3. Color: color selected by Architect
4. Gloss: 30 ± 5
5. Thickness: 1.64 mm base metal thickness.
6. Profile: 1.625 X 4 inch (41.28mm X 101.6mm) 24 ft (7315.2mm) rectangular beam.

B. ACCESSORIES
1. Ceiling Beam Hanger, Hanger Bracket, Beam Spline Connection Top, Beam End Cap.

C. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275) hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including J-trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal soffits.

D. Panel Fasteners: Self-tapping concealed Stainless-Steel type 304 screws designed to withstand design loads.

E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.4 FABRICATION

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.5 FINISHES

A. Panels and Accessories:
1. Architect to select from the full line of finishes.
2. MX-10 is to be a wood-look woodgrain print patterns
   a. Basis of Design: OCM Timbermet

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

1. Soffit Framing: Wire tie furring channels to supports.

2. Trim in field for soffit light fixtures and coordinate with light fixtures submittals.

3.2 INSTALLATION

A. Metal Soffit Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

3.3 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 07 42 93

SECTION 07 54 23 - THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Section Includes:
1. Adhered thermoplastic polyolefin (TPO) membrane roofing system.
2. Roof insulation.
3. Roof walkways.
4. Cover boards. See also 06 16 00 Sheathing for Glass-mat gypsum roofing coverboard
5. Slip sheet for PV ballast racking (basket)

C. Related Requirements:
1. Division 06 Section “Rough Carpentry” for Laminate Strand Lumber (LSL) Parapet Cap
2. Division 07 Section “Sheet Metal Flashing, Trim, And Copings”
3. Division 26 Section “Photovoltaic Collectors”

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit SSc5: For roof materials, indicate that roof materials comply with Solar Reflectance Index (SRI) requirement.

C. Shop Drawings: For roofing system. Include roof plans, sections, details, and attachments to other work, including the following:

D. Samples for Verification: For the following products:

1. Roof membrane and flashings, of color specified.
2. Walkway pads, of color required.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

3. Roof membrane manufacturer’s guidelines for PV are to be provided and coordinated to meet requirements and documented er the guidelines.

C. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

D. Evaluation Reports: For components of roofing system, from ICC-ES.

E. Field Test Reports:

1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

F. Field quality-control reports.

G. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

B. Source Limitations: Obtain components including fasteners for membrane roofing system from same manufacturer as membrane roofing.

1.6 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, General Contractor, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.

7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

A. Roof Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: (20) years from date of Substantial Completion.

B. Installer’s Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system, for the following warranty period:

1. Warranty Period: (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.

1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746 and ASTM D4272.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Wind Uplift Resistance: Design roofing system to resist the wind uplift pressures noted on the Structural Drawings when tested according to UL 580, or UL 1897.

D. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.

E. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

F. Solar Reflectance Index (SRI): Three-year-aged SRI not less than 64 or initial SRI not less than 82 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

G. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.79 and an initial emissivity of not less than 0.78 when tested according to CRRC-1.

2.2 TPO MEMBRANE ROOFING

A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced TPO sheet.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Tremco CPG Inc. (Basis of Design)
b. Versico Incorporated.
c. Carlisle SynTec Incorporated.
d. Firestone Building Products Company.
e. GAF Materials Corporation.
f. Johns Manville.

2. Thickness: 80 mils, nominal.

3. Breaking Strength: 335 lbf x 320 lbf
4. Factory Seam Strength: 160 lbf
5. Puncture Resistance: greater than 380 lb.
6. Exposed Face Color: White

2.3 AUXILIARY MEMBRANE ROOFING MATERIALS

A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard reinforced TPO sheet flashing, of same color as TPO sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Bonding Adhesive: Manufacturer's standard.

E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer in keeping with warranty requirements.

G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

H. Precast concrete splash blocks set below roof downspouts.

2.4 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by TPO roof membrane manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.

B. Acceptable manufacturers include:

1. ISO95+GL by Firestone
2. Polyisocyanurate H-panel by Hunter Panels (Basis of Design)
3. AC Foam-II by Atlas
4. Approved equal by others.

C. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Compressive Strength: 20 psi.
2. Size: 48 by 96 inches, unless otherwise recommended by manufacturer.

3. Thickness: Provide 3 layers at minimum R value 13 per board. Built up minimum R38 roof.

D. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.

E. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
Slope: Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

F. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes for sloping to drain. Fabricate to slopes indicated.

2.5 ROOF COVER BOARDS

A. Acceptable manufacturers include:
1. GAF
2. USG Corporation
3. Approved equals by others.

B. Cover Board ASTM C 1278/C 1278M, cellulosic-fiber water-resistant gypsum substrate:
1. Glass-Mat Gypsum Roofing Coverboard: ASTM E84
a. Type & Thickness: 1/2” thick
b. Basis of Design: DensDeck by GAF or approved equal.
2. Securock by USG Corporation

C. Dimensions: 1/2 inch thick.

2.6 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer.

D. For adhesives and sealants used inside the weatherproofing system, documentation including printed statement of VOC content to verify compliance.

2.7 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway rolls, approximately 3/16 inch thick, and acceptable to membrane roofing system manufacturer.

1. Size: Approximately 30 inches wide.

2. Color: White with yellow borders.

2.8 SLIP SHEET MATERIALS

A. Material: Slip sheets for ballasted PVs shall be provided to meet the warranty requirements of the TPO manufacturer.
1. Coordinate locations and size with PV Installer, refer to drawings for areas of proposed PVs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. For areas of steel roof decks:

a. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie into existing roofing to maintain weathertightness of transition.

3.4 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with long joints continuous at right angle to flutes of decking.
2. Install all layers of insulation with end joints staggered and offset from previous layer of insulation.
3. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.

    a. Trim insulation so that water flow is unrestricted.

4. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

    a. Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

5. Adhere each subsequent layer of insulation to substrate:

    a. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

D. Install tapered insulation under area of roofing to conform to slopes indicated.

E. Install insulation under area of roofing to achieve the required thickness. Install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

3.5 COVER BOARD INSTALLATION

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

    a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

a. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 ADHERED MEMBRANE ROOFING INSTALLATION

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

E. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing.

F. Apply membrane roofing with side laps shingled with slope of roof deck where possible.

G. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

3.7 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow too partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.8 WALKWAY INSTALLATION

A. Flexible Walkways:

1. Install flexible walkways at the following locations:

a. Around perimeter of each rooftop unit.
b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
c. Between each roof access location and each rooftop unit location or path connecting rooftop unit locations.
d. Top and bottom of each roof access ladder.
e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. As required by roof membrane manufacturer's warranty requirements.

2. Provide minimum 1-inch and maximum 6-inch gap between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.9 SLIPSHEET INSTALLATION

A. Install slipsheets per manufacturer’s written instructions and requirements to conform to the roofing warranty requirements.

3.10 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

C. Additional inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.11 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 54 23

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.1 SUMMARY

A. Section Includes:

1. Formed roof-drainage sheet metal fabrications.
2. Formed Low-sloped sheet metal flashing.
3. Manufactured sheet metal fascia and drip edge trim.
4. Box type Gutter

B. Related Sections:

A. Related Requirements:

1. Section 06 10 00 "Rough Carpentry**"** for wood nailers, curbs, and blocking, Laminate Strand Lumber (LSL) Parapet Cap.
2. Section 04 20 00 "Unit Masonry" for installation of manufactured sheet metal through-wall flashing and trim integral with masonry.

1.2 ACTION SUBMITTALS

A. LEED Submittals:
1. Comply with Section 01 81 13
   a. MR Credit 2: BPDO – Environmental Product Declarations (EPD): For each product.
   b. MR Credit 4: BPDO – Material Ingredient Reports and/or Material Ingredient Optimization Reports and Action Plans.
2. Recycled Content of Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent. For recycled content, indicate postconsumer and preconsumer recycled content and cost.

B. Product Data: For each type of product.

C. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Distinguish between shop- and field-assembled work.
3. Include identification of finish for each item.
4. Include pattern of seams and details of termination points, expansion joints and expansion-joint covers, direction of expansion, roof-penetration flashing, and connections to adjoining work.
5. Shop drawings shall include project-specific interface conditions and depict integration with adjacent roof, wall panels and exterior wall conditions.

D. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.6 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change**:** 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Recycled Content of Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent. For recycled content, indicate postconsumer and preconsumer recycled content and cost.

C. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat finish.

1. Exposed Coil-Coated Finish:
   a. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2.3 SHEET METAL FABRICATIONS

A. Roof-Edge Fascia: Manufactured, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet (3.6 m) and a continuous formed- or extruded-aluminum anchor bar with integral cleat to engage fascia cover. Provide matching corner units. Roof Edge Flashing shall meet ANSI/SPRI/FM 4435/ES-1 tested.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide EverGuard Fascia by GAF with tapered profile. TPO coated metal cover with weldable membrane.
      a. Hickmann
      b. Pac-Tite
      c. Or approved equal.
   2. Material: Formed Aluminum: 0.050” thick.

3. Snap-on, single-ply fascia compatible with TPO.
4. Fascia Height: As dimensioned on the drawings.
5. Finish: Prefinished Kynar.
6. Colors: As selected by Architect from manufacturer's metallic and premium color selections:
   a. Color 1: "Silversmith"
   b. Color 2: "Weathered Zinc"

B. TPO Drip Edge Flashing: Manufactured, drip edge flashing consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet (3.6 m) and a continuous formed- or extruded-aluminum anchor bar with integral cleat to engage fascia cover. Provide matching corner units. Roof Edge Flashing shall meet ANSI/SPRI/FM 4435/ES-1 tested.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide EverGuard Drip Edge by GAF with TPO coated metal cover with weldable membrane.
      a. Hickmann
      b. Pac-Tite
      c. Or approved equal.
   2. Material: Formed Aluminum: .050" thick.
   3. 22 ga Galv. steel continuous cleat.
   4. Face Height: As dimensioned on the drawings.
   5. Finish: Prefinished Kynar.
   6. Colors: As selected by Architect from manufacturer's metallic and premium color selections:
      a. Color 1: "Silversmith"
      b. Color 2: "Weathered Zinc"

C. Box Gutter: Manufactured, .050" prefinished aluminum gutter box style 5.25"x5.25" in section lengths not exceeding 12 feet (3.6 m) and providing 2 piece extruded aluminum internal bracket 2-ft o.c.. Provide matching end cap and downspout.
   1. Basis-of-Design Product: EverGuard WR Box Gutter
      a. Hickmann
      b. Pac-Tite
      c. Or Approved Equal.

      d. Finish: Prefinished Kynar. Premium colors architect to select, basis color to be Silversmith

2.4 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Englert Inc; Metalman HT.
   b. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
   c. Grace Construction Products, a unit of W. R. Grace & Co.-Conn.; Grace Ice and Water Shield HT.
   d. Henry Company; Blueskin PE200 HT.
   e. Kirsch Building Products, LLC; Sharkskin Ultra SA.
   f. Polyguard Products, Inc.; Deck Guard HT.
   g. Protecto Wrap Company; Protecto Jiffy Seal Ice & Water Guard HT.
   h. SDP Advanced Polymer Products Inc; Palisade SA-HT.

2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.
3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.

2.5 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular-threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

   1. General:

      a. Exposed Fasteners: Heads matching color of sheet metal roofing using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of roofing.
      b. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed; with hex-washer head.
      c. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
   2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with interlocking counterflashing on exterior face, of same metal as reglet.
   1. Manufacturer; OMG Edge Systems, Reglet and Flashing; Drive-Lock (In-Wall) DLR 625 or approved equal.
      a. Material: Aluminum 0.050 ga, reglet and 0.032 ga. flashing.

b. Finish: Natural mill aluminum.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Furnish hidden gutter strap brackets fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.

B. Basis-of-Design Product: Subject to compliance with requirements, provide Hickman, Box Profile, or comparable products.
1. Gutter Material: Formed Aluminum
2. Expansion Joints: Lap type.

a. Finish: Prefinished Kynar 500, two-coat.
b. Shape: Style ‘F’ – box. See drawings for profile.
c. Size: 6” x 5”
d. Aluminum: 0.050 inch thick.
e. Color: As selected by Architect from manufacturer's full range.

1. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from the same material as downspouts and anchors.

a. Finish: Prefinished Kynar 500, two-coat.
b. Hanger Style: Strap.
c. Size: 6” x 4”.
d. Aluminum: 0.040 inch thick.
d. Color: As selected by Architect from manufacturer's full range.

C. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:
1. Aluminum: 0.032 inch (0.81 mm) thick.
d. Color: As selected by Architect from manufacturer's full range.

2.7 MANUFACTURED SHEET METAL FASCIA CLADDING AND TRIM

A. Aluminum cladding, 18-gauge, shop fabricated/extruded, with hemmed edges and concealed cleats/fasteners. Cladding shall have a 3-coat fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat, along with a removable temporary protective coverings and strippable films.

2.8 FABRICATION, GENERAL

B. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Obtain field measurements for accurate fit before shop fabrication.
2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

G. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.

4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

3.2 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

C. Install work with laps, joints, and seams that are permanently watertight and weatherproof.

D. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with cleat anchored to substrate.

1. Reglets to occur where adhered elastomeric roof membrane meets masonry walls and extends up to meet the reglet. Reglet should be located a minimum of 8” above the roof surface.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches (100 mm) over base flashing.
3. Lap counterflashing joints minimum of 4 inches (100 mm).
4. Secure in a waterproof manner by means of interlocking folded seam unless otherwise indicated.

F. Reglets: Installation of reglets is specified in Section 04 20 00 "Unit Masonry."

3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean off excess sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION 07 62 00

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

C. Section Includes:

1. Penetrations in fire-resistance-rated walls.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 INFORMATIONAL SUBMITTALS

A. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations. B. Product test reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:

1. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems bearing marking of qualified testing and inspection agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Grace Construction Products.
   2. Hilti, Inc.
   3. Nelson Firestop Products.
   4. 3M Fire Protection Products.
   5. Tremco, Inc.; Tremco Fire Protection Systems Group.

2.2 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fireresistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

   1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

   1. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
   2. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

D. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

   1. Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping. D. Install fill materials for firestopping by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or selfadhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.3 FIELD QUALITY CONTROL

A. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.

B. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 07 84 13

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. This Section includes joint sealants, fillers and adhesives for the following applications, including those specified by reference to this Section:

1. Interior joints in the following vertical surfaces and horizontal surfaces:

    a. Control and expansion joints on exposed surfaces of masonry walls.
    b. Joints where countertops abut vertical surfaces.
    c. Perimeter joints between interior wall surfaces and frames of interior doors windows, elevator entrances and wood bases.
    d. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    e. Tile control and expansion joints.
    f. Stone threshold setting.

B. Related Sections include the following:

1. Division 8 Section "Glazing" for butt glazing sealant.
2. Division 7 Section " Built up Asphalt Roofing System" for roof expansion joints.
3. Division 9 Section "Gypsum Board Assemblies" for locations of perimeter joints of gypsum board partitions to reduce sound transmission, with products specified in this section.
4. Division 8 Sections "Wood Doors" and Hollow Metal Doors and Frames for sealants applied to junction of door frames and partitions.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Field Test Report Log: For each elastomeric sealant application.

E. Warranties: Special warranties specified in this Section.

1.5 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two (2) years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five (5) years from date of Substantial Completion.

C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance are caused by accumulation of dirt or other atmospheric contaminants. PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

C. Architectural Sealants:

1. Toxicity/IEQ:

a. Comply with applicable regulations regarding toxic and hazardous materials, and as specified. Sealants must meet or exceed requirements South Coast Air Quality Management District (SCAQMD) #1168.
b. Sealants containing aromatic solvents, fibrous talc, formaldehyde, halogenated solvents, mercury, lead, cadmium, chromium and their compounds, are not permitted.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquidapplied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, and for all countertop sealants provide products that comply with 21 CFR 177.2600.

D. Single-Component Neutral-Curing Silicone Sealant [ES-1]:

1. Available Products:

    a. GE Silicones; SilPruf SCS2000.
    b. Pecora Corporation; 864.
    c. Pecora Corporation; 890.
    d. Polymeric Systems Inc.; PSI-641.
    e. Sonneborn, Division of ChemRex Inc.; Omniseal.
    f. Tremco; Spectrem 3.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 50.
4. Use Related to Exposure: NT (nontraffic).

E. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant [ES-2]:

1. Products:

    a. Dow Corning; 786 Mildew Resistant.
    b. Pecora Corporation; 898.
    c. Tremco; Tremsil 600.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and O.

2.4 LATEX JOINT SEALANTS

A. Latex Sealant [LS]: Comply with ASTM C 834, Type P, Grade NF.

B. Available Products:

1. Bostik Findley; Chem-Calk 600.
2. Pecora Corporation; AC-20+.
3. Schnee-Morehead, Inc.; SM 8200.
4. Sonneborn, Division of ChemRex Inc.; Sonolac.
5. Tremco; Tremflex 834.

2.5 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant [AS] for Exposed and Concealed Joints [AS] Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:

1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

2. Elastomeric Flexible Clear Sealants:

a. Sound Specialties Coatings Corporation: Slickthane high solids polyurethane-acrylic blend, single component ambient or heat cure, zero to low VOC, waterborne. B. Non-hardening fire-stop sealant:

1. Gun or trowel-applied intumescent sealant: 3M “CPW-25WB+” or approved equal.
2. Moldable intumescent putty: 3M “Fire Barrier Moldable Putty+” or approved equal.
3. Non-intumescent silicone sealant: 3M “Silicone Fire Stop”, USG “Smokeseal” or approved equal) may be used in lieu of the sealant on foam rod in noise sensitive walls that are also fire rated.

2.6 FOAM BACKER ROD

A. Closed cell polyethylene backer rod, ASTM C1193

B. Acceptable Manufacturers: ITP, Nomaco, or approved equal (available through Tom Brown, Inc. 800446-2298)

2.7 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.8 EXPANSION JOINT FILLER

A. W.R. Meadows, Sealtight, multi-purpose expansion-contraction joint filler in recommended thickness for anticipated range of joint movement. Adhere to one plane surface.

2.9 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

2.10 ADHESIVES

A. Material recommended by adhesive manufacturer for application of material to substrate for intended application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.

c. Unglazed surfaces of ceramic tile.
d. Other porous substrates.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

a. Porcelain enamel.
b. Glazed surfaces of ceramic tile.
c. Other porous substrates.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Sealants for Stone Masonry: Provide non-staining sealant systems as certified by test data and as recommended by manufacturer for sealing interior and exterior stone facing joints.

D. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

1. Furnish and install acoustical sealant at the following locations:

a. All penetrations of partition, wall, and floor construction by ductwork, conduit, piping, or structure
b. All termination of partitions enclosing Noise Critical Spaces to abutting construction (e.g. partitions, structure, etc.)
c. Both sides of door frames to abutting construction where doors are scheduled to have acoustical seals
d. Both sides of window frames to adjacent construction at windows in partitions enclosing Noise Critical Spaces.
e. Perimeter of penetrations through sound isolating ceilings, roof systems, and floor systems

2. Backer Rod shall be used in all joints greater than ¼ inch. Product to be constructed of closed cell foam, or appropriate resilient material for sealant. Dimension shall be minimum 30% greater than joint width, unless otherwise indicated on details.

E. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

F. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

G. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

H. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

I. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:

1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch. Hold edge of sealant bead 1/4 inch inside masking tape.
3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.

4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.

J. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

1. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field-adhesion-test log.
2. Inspect tested joints and report on the following:

   a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
   b. Whether sealants filled joint cavities and are free of voids.
   c. Whether sealant dimensions and configurations comply with specified requirements.

3. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

4. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without

deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 Sealant Schedule:

LOCATION	SYSTEM NO.	CUSTOM COLOR
Masonry/Masonry	ES-1	Yes
Masonry/Metal	ES-1	Yes
Metal/Metal	ES-1	Yes
Tile/Fixtures	ES-2	Yes
Painter's Caulk	LS	No
Interior Acoustical Joints	AS	No

END OF SECTION 07 92 00

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. Section includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Related Requirements:
1. Division 08 Section "Flush Wood Doors" for interior solid-core wood doors installed in aluminum frames.
2. Division 08 Section "Aluminum-Framed Entrances" for aluminum door frames.
3. Division 08 Section "Glazing" for glass view panels in doors.
4. Division 08 Section "Door Hardware" for hardware requirements.
5. Division 09 Section "Painting" for field painting primed doors and frames.

1.3 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, and finishes.
2. MR Credit 2: Environmental Product Declarations
   a. Metal doors, if available

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

C. Door Schedule: Indicate door and frame location, type, size, fire protection rating, and swing. Use the same reference designations indicated on the Drawings in preparing schedule for doors and frames.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufactures that are not current members of the Steel Door Institute.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS.

A. Special warranties.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.7 QUALITY ASSURANCE

A. Provide doors and frames complying with ANSI/SDI 100 “Recommended Specifications for Standard Steel Doors and Frames” and as specified.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: (5) years from date of Substantial Completion.

B. Installer's Warranty: Installer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CECO Door Products.
2. Curries Company (Basis-of-Design).
3. Steelcraft.

2.2 PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Product Certification: AMMA certified with label attached to each door.

B. Thermal Transmittance for exterior assembly (door and frame): U-factor of max. 0.34 Btu/sq. ft. x h x deg F.

2.3 DOOR AND FRAMES, GENERAL

A. Hollow Metal Doors: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

B. Hollow Metal Frames: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

2.4 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

1. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

B. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Basis-of-Design Products:
   a. Curries Company (CU) - Steel-Stiffened - 747 Series.

2. Design: Flush panel.
3. Core Construction: Manufacturer's standard kraft-paper honeycomb, or one-piece polystyrene core, securely bonded to both faces.

   a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

4. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Basis of Design Product: Curries Company (CU) - M Series.
2. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
3. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.

2.5 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Basis-of-Design product:

   a. Curries Company (CU) - Fiberglass Core – 777 (Trio E) Series.

2. Design: Flush panel.

3. Core Construction: Manufacturer's standard fiberglass and vertical steel-stiffener core. Minimum 22 gauge steel-stiffeners at 6 inches on-center construction attached by spot welds spaced not more than 5" on centers. Spaces between stiffeners filled with fiberglass insulation (minimum density 0.8#/cubic ft.).

4. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.

1. Basis-of-Design Product:
   a. Curries Company (CU) - Thermal Break TQ Series.
2. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames. Tested for thermal performance in accordance with NFRC 102, and resistance to air infiltration in accordance with NFRC 400. Where indicated provide thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate with 1/16” positive thermal break and integral vinyl weatherstripping.
3. Fabricate fully welded frames with mitered or coped corners. Profile as indicated on drawings.
4. Frames: Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.

2.6 BALLISTIC RATED METAL DOORS

A. All ballistic rated metal doors are to be Level 3 bullet resistant 16-gauge steel doors.

B. Basis of design: Total Security Solutions, or approved equal.

2.7 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.8 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.

E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

2.9 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
3. Louvers: Factory cut openings in door and install louvers into prepared openings where indicated.
4. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Electrical Raceways: Provide hollow metal doors to receive electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through-wire transfer hardware or wiring

harness specified in hardware sets in Division 08 Sections "Door Hardware" and "Access Control Hardware". Wire nut connections are not acceptable.

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

    a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

    b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
        5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.

10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.10 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

3.5 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

END OF SECTION 08 11 13

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. Section Includes:

1. Solid-core flush wood veneer-faced doors for transparent finish.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Division 08 Section "Aluminum-Framed Entrances" for aluminum door frames.
2. Division 08 Section "Glazing" for glass view panels in flush wood doors.
3. Division 08 Section "Door Hardware" for hardware requirements.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site. Discuss coordination with hardware and access control installers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door louvers.
5. Door trim for openings.
6. Door frame construction.
7. Factory-machining criteria.
8. Factory-finishing specifications.

B. Sustainable Design Submittals: Comply with Division 01 Section "Sustainable Design Requirements – LEED".

1. MR Credit 2: Environmental Product Declarations

    a. Wood doors, if available

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
2. Details of frame for each frame type, including dimensions and profile.
3. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
4. Dimensions and locations of blocking for hardware attachment.
5. Dimensions and locations of mortises and holes for hardware.
6. Clearances and undercuts.
7. Requirements for veneer matching.
8. Doors to be factory finished and application requirements.

D. Door Schedule: Indicate door and frame location, type, size, fire protection rating, and swing. Use the same reference designations indicated on the Drawings in preparing schedule for doors and frames.

E. Samples for Initial Selection: For factory-finished doors.

1. Color charts consisting of actual materials in small sections showing the full range of colors available for stained finishes.

F. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
2. Light Opening Moldings: Minimum 6 inches long, for each material, type, and finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Special warranties.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.

B. Quality Standard: Comply with WDMA Architectural Woodwork Quality Standards Illustrated.

1. Provide WDMA Quality Certification Labels or a WDMA letter of licensing for Project indicating that doors comply with requirements of grades specified.
2. When requested, provide evidence that the installer has successful experience completing projects of similar scope and with products as specified herein.

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

D. Forest Certification: Provide wood products made from forests certified by an FSC-accredited certification body.

1. All non-FSC wood in assemblies with FSC-certified wood: Meet the FSC Controlled Wood (CW) criteria.

1.8 MOCKUPS

A. Room Mockups: Include doors for room mockups that will be used to demonstrate aesthetic effects, perform preconstruction testing, and to set quality standards for materials and installation. See Division 01 Section "Mockups" for additional construction requirements.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Delamination of veneer.
    b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
    c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty shall be in effect during specified period of time from date of Substantial Completion.
4. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain flush factor-finished stained wood doors single manufacturer.

B. Basis-of-Design Product: subject to compliance with requirements, provide ‘Aspiro Series’ flush wood doors by Masonite Architectural or a comparable product by one of the following manufacturers, but not limited to:

1. VT Industries
2. RK Doors

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Wood Door and Frame Assemblies: Complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to UL 10C or NFPA 252.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2.3 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A “Industry Standard for Interior Architectural Wood Flush Doors”.

2.4 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Doors:

1. Performance Grade: ANSI/WDMA I.S. 1A Heavy Duty.
2. ANSI/WDMA I.S. 1A Quality Grade: Premium.
3. Faces: Single-ply wood veneer not less than 1/50 inch thick.

    a. DR-1

    b. Species: White Birch.
    c. Cut: Plain sliced (flat sliced).
    d. Match between Veneer Leaves: Book match.
    e. Assembly of Veneer Leaves on Door Faces: Running match.
    f. Pair and Set Match: Provide for doors hung in same opening.
    g. Finish: Clear
    h. Installation: Typical Flush wood door per door schedule.

4. Exposed Vertical Edges: Same species as faces - Architectural Woodwork Standards edge Type A.

    a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
    b. Fire-Rated Pairs of Doors: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
    c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

        1) Screw-Holding Capability: 475 lbf in accordance with WDMA T.M. 10.

5. Core for Non-Fire-Rated Doors:

    a. ANSI A208.1, Grade LD-2 particleboard.

        1) Blocking: Provide wood blocking in particleboard-core doors as needed for installation of hardware and to eliminate through-bolting hardware.

6. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.

    a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as follows:

        1) 5-inch top-rail blocking.
        2) 5-inch bottom-rail blocking, in doors indicated to have protection plates.
        3) 5-inch midrail blocking, in doors indicated to have armor plates.
        4) 5-inch midrail blocking, in doors indicated to have exit devices.

7. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.5 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Flush rectangular beads.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated on Drawings. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.6 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
2. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Glazing."

2.7 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Transparent Finish:

1. ANSI/WDMA I.S. 1A Grade: Premium.
2. Finish: ANSI/WDMA I.S. 1A TR-6 Catalyzed Polyurethane.
3. Staining: As selected by Architect from manufacturer's full range.
4. Effect: Open-grain finish.
5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Division 08 Section "Door Hardware."

B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Install frames level, plumb, true, and straight.

1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
2. Anchor frames to anchors or blocking built in or directly attached to substrates.

    a. Secure with countersunk, concealed fasteners and blind nailing.

3. Install fire-rated doors and frames in accordance with NFPA 80.
4. Install smoke- and draft-control doors in accordance with NFPA 105.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 14 16

SECTION 08 32 00 - DETENTION DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Hollow Metal detention doors and frames meeting ASTM F1450 Grades 1-4.
   2. Hollow Metal detention frames for interior vision panels.
   3. Hollow Metal detention framing system for glazed partitions (borrowed lights).
   4. Preparation of detention metal doors and frames to receive detention hardware, including reinforcing, drilling, and tapping.
   5. Furnishing anchors for building into masonry work.
   6. Factory prime painting of all hollow metal work.
   7. Installation and final adjustment of detention and finish hardware.

B. Related Sections:
   1. Division 04: Unit Masonry for anchoring and grouting of frames in masonry partitions.
   2. Division 08: Hollow Metal Doors and Frames.
   3. Division 08: Door Hardware.
   4. Division 08: Detention Hardware.
   5. Division 08: Glazing.
   6. Division 26: Electrical.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM F1450: Standard Test Methods for Hollow Metal Swinging Door Assemblies for Detention and Correctional Facilities.
   2. ASTM F1915: Standard Test Methods for Glazing for Detention Facilities.
   3. ASTM 1577: Standard Test Methods for Detention Locks for Swinging Doors.

B. Hollow Metal Manufacturers Association (HMMA):
   1. NAAM/HMMA 863: Guide Specifications for Detention Security Hollow Metal Doors and Frames

C. Consumer Product Safety Commission (CPSC):
   1. CPSC 16 CFR 1201: Safety Standard for Architectural Glazing Materials.

D. American National Standards Institute (ANSI):
   1. ANSI Z97.1: Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

E. Glass Association of North America (GANA)
   1. GANA – Glazing Manual.
   2. FGMA – Sealant Manual.

F. ICC (IBC) - International Building Code, 2021 Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 SYSTEM DESCRIPTION

A. Performance Requirements:
   1. Detention Rating: Must meet ASTM F1450 Grades 1-4 and ASTM F1577 as specified. Detention rating of glazing must meet ASTM F1915 Grades 1-4 as specified.
   2. Testing Laboratory: Test must be conducted by a nationally recognized independent testing laboratory.

B. Listings and Labels:
   1. Detention rated doors and framing system shall be under current follow-up service by a nationally recognized independent laboratory approved by OSHA and maintain a current listing or certification. Assemblies shall be labeled in accordance with limits of listings.

C. Appearance:
   1. Detention door and door frame assembly shall have a neat finished appearance with minimum joints at decorative cover intersections.

1.4 SUBMITTALS

A. Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedure Section.

B. Product Data: Submit latest edition of manufacturer's product data providing product descriptions, technical data and installation instructions. Include door designation, type, level and model, material description, hardware preparation, core, label compliance, and finishes.

C. Shop Drawings: Submit shop drawings showing layout, profiles and product components of doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware reinforcements, and details of joints and connections. Show anchorage and accessory items.

D. Samples: Submit samples for finishes, colors and textures.

E. Door Schedule: Use same reference designations indicated on Drawings.
   1. Indicate coordination of glazing frames and stops with glass and glazing requirements.

1.5 QUALITY ASSURANCE

A. Except as amended herein, all detention hollow metal shall be manufactured, tested, and certified in conformance with standards ASTM FI450—97 for grade 2 openings and NAAMM HMMA 863—97. Installation shall be per NAAMM HMMA 840—99.

1.6 DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division1 Product Requirements Sections.

B. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

C. Delivery: Deliver materials to specified destinations in manufacturer's or distributor's packaging undamaged, complete with installation instructions. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

D. Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and are acceptable to the Architect. Otherwise, remove and replace damaged or defective items as directed.

E. Storage and Protection: Store off ground, under cover, protected from weather and construction activities and at temperature conditions recommended by manufacturer.

1.7 FABRICATION DIMENSIONS

A. Field Measurements: Verify actual measurements for openings by field measurements before fabrication. Show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.8 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document. Manufacturer's warranty is not intended to limit other rights that the Owner may have under the Contract Documents.
   1. Warranty Period: 5 years from date of shipping.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Trussbilt, Inc.
   2. Apex Industries.
   3. Titan Metal Products.
   4. Habersham Metal Products.
   5. Architectural Opening, Inc., Longwood, FL

2.1 MATERIALS

A. Detention rated doors and door frames meeting ASTM F1450 Grades 1-4 and ASTM F1577 as specified. Detention rating of glazing must meet ASTM F1915 Grades 1-4 as specified.

B. Hot-Rolled Steel Sheets for frames: ASTM A 569/A 569M, prime quality carbon steel; free of scale, pitting, or surface defects; pickled and oiled.

C. Cold-Rolled Steel Sheets for doors and frames: ASTM A 366/A 366M, pickled; stretcher-leveled standard of flatness.

D. Galvanized Carbon Steel Sheet for exterior applications: ASTM A 526, G-90 zinc coating; mill phosphatized; suitable for exposed applications.

E. Provide manufacturer's standard units for supports, anchors, inserts, and fasteners, except hot-dip galvanized units for exterior use complying with ASTM A 1J3, Class B.

F. Factory Prime Paint: Rust-inhibitive zinc-chromate primer conforming to SSPC Paint Spec. No. 2-64 or No. 3-64 which is alkali and acid resistant and fully cured before shipment.

G. Steel plate reinforcement shall conform to ASTM A 283, Grade C.

H. Sound-Deadening Material: For hollow metal doors, provide a heat-retarding and sound deadening inorganic filler, such as mineral wool, conforming to the requirements of the American Insurance Association.

I. Door Vision Panel: Glazing must meet ASTM F1915 Grades 1-4 as specified. Individual lites shall be permanently identified with a listing mark.

2.2 FABRICATION

A. Connections shall be welded seams and joints including reinforcements. Fitting and fabrication shall be accurate with surfaces free from warp, wave, buckle, or other defects; made with square corners and angles, unless otherwise shown; members set in proper alignment; surfaces straight and true to plane; molds, edges, and arises straight and sharp. Trim moldings and like components shall be neatly and accurately mitered or coped together and joint welded. Welded joints shall be neatly made, dressed clean, smooth, and flush with surface of base metal. Exposed face jointing of all work shall be made invisible.

B. Concealed reinforcement of sheet or bar steel shall be provided for all hardware and for attached work where required for field conditions and as indicated.

C. Hardware fitting shall be done at the shop. Prepare hollow metal units to receive detention hardware, including cutouts, reinforcing, drilling, and tapping in accordance with final Finish Hardware Schedule and Templates provided by the hardware supplier. Comply with applicable requirements of ANSI A 115 "Specifications for Door and Frame Preparation for Hardware."

D. Locate hardware as shown on final shop drawings in accordance with "Recommended Locations for Builder's Hardware for Custom Doors" published by the Door and Hardware Institute.

E. Unless otherwise indicated, provide countersunk TORX security pin head screws and bolts for exposed locations.

F. Gauges: the following list of minimum gauges refer to the United States Standard Gauge for sheet steel:

1. Door face sheets:	No. 14 gauge
2. Frames:	No. 12 gauge
3. Interior and exterior rough bucks:	No. 12 gauge
4. Interior and exterior angle floor knees:	No. 10 gauge
5. Interior frame anchors:	No. 10 gauge
6. Interior and exterior T-type anchors:	No. 10 gauge
7. Interior and exterior channel spreaders:	No. 16 gauge

8. Interior mullions and framing for glazed partitions (security), including bases:	No. 12 gauge
9. Hardware reinforcement for hinges, strikes, overhead door holders, door check brackets, etc. unless otherwise specified:	Equal to the major dia. of screw
10. Glazing moldings:	No. 12 gauge

G. Glass Moldings: Loose moldings, 10-gauge minimum sheet steel, with mitered corners, on non-security side of door, secure to framed opening with countersunk cadmium or zinc-coated spanner head machine screws uniformly spaced 9-inches o.c. maximum. Moldings shall be flush with face of door.

2.3 DETENTION TYPE HOLLOW METAL FRAMES

A. Provide heavy gauged pressed steel frames for doors, glazed partitions of sizes and profiles indicated and scheduled, where security construction is required (refer to assemblies with security type locksets).

B. Frames for interior openings shall be either commercial grade cold-rolled steel conforming to ASTM A 366 or commercial grade hot-rolled and pickled steel conforming to ASTM A 569. All door frames shall have fully mitered corner joints, including stops, and shall be continuously welded and dressed to match adjacent metal.

C. Frames for multiple openings or glazed partitions shall have mullion and/ or rail members which are closed shapes, having no visible seams or joints on the faces. Joints between faces of abutting members shall be reinforced with splice plates and securely welded and dressed to match adjacent metal.

D. Frames shall be factory assembled to minimize field splicing, within practical limits. Splice details shall be clearly and completely indicated on manufacturer's shop drawings for the Architect's consideration' for approval.

E. Hardware:

1. Frames shall be mortised, reinforced, drilled, and tapped at the factory for templated hardware in accordance with the approved hardware schedules and templates provided by the hardware supplier.
2. Where surface mounted hardware is called for, frames shall have reinforcing plates only and drilling and tapping shall be done by field installation personnel.
3. Where electrical locks are used, a special housing shall be provided with a 3/16-inch backup for attachment of the lock and a lock cover plate.
4. For swing doors where applicable, the Work of this Section shall include the furnishing and installation of a rigid galvanized electric conduit concealed in frame and running between electric lock enclosure and junction box for door position switch. Conduit shall be secured to inside of frame. Junction box shall be positioned for easy access for running the wires and making final connections. Refer to Division 26 for electrical requirements.
5. For mortise butts, provide a 3/16-inch by I-1/2 inch by full height of jamb reinforcing plate, offset at each hinge location and factory drilled and tapped. Reinforcing plates shall be adequately welded to frames with fillet welds.
6. Lock or keeper preparation shall be in accordance with the recommendations of the hardware manufacturer. Reinforcements shall be not less than 3/16—inch thick. All cutouts

and reinforcements shall be protected with pressed steel mortar guards on the inside of the frame.

F. For glazed partitions extending to the floor, provide 12-gauge continuous steel channel runner for securing all partition bases. Fasten to floor slab with expansion bolts spaced not more than 18 inches o.c.

G. Frames for installation in masonry walls shall be provided with non-removable adjustable jamb anchors. Anchor straps shall not be less than 10-gauge by 2-inches by 10-inches corrugated and/or perforated for bond. Two anchors shall be provided in each jamb for openings up to and including J feet in height and one additional anchor in each jamb for each additional 30 inches in height, or part thereof.

H. Frames over 3 feet wide shall have a channel stiffener formed of not less than 12-gauge steel welded into the head of the frame at the factory. Such head stiffeners shall not be used as lintels or load carrying members.

I. Frames shall be provided with steel spreader angles, or channels, temporarily attached to the bottoms of both jambs, one on each side of the opening to serve as a brace during shipping and handling.

J. Glazed openings in frames and borrowed lights shall be provided with removable individual glazing beads. Glazing beads shall be to suite bite and rabbet required for type of glass used and of the same gauge as the associated frame. Glazing beads shall be factory punched and countersunk for flathead machine screws and shall be spaced to fit glass and glazing specified. Glazing beads shall be secured at the factory with slotted flathead machine screws. Spanner flathead security machine screws and special screw drivers shall be used for glass and glazing in the field. Screws shall be located not more than 2 inches on center. Stops shall be primed and finished in the same fashion as frames.

2.4 DETENTION TYPE HOLLOW METAL DOORS

A. Door faces shall be made of commercial quality stretcher level cold-rolled steel free of scale, pining, and other blemishes or defects. Door shall be custom made full-flush design, internally reinforced, sound deadened and insulated, 2 inches thick.

B. Face sheets shall be internally stiffened and reinforced with vertical continuous steel of at least 16-gauge channels spaced 4 inches o.c., extending full height vertically and width horizontally and occupying the full thickness of the interior space between the door faces, and joined by spot welds. Welds shall not be more than 3 inches on center vertically and shall be invisible from the outside. All voids inside the door shall be sound deadened and insulated with 6 lb. density mineral rock wool and completely filled to prevent internal condensation.

C. Vertical door edges shall be beveled 1/8 inch in 2 inches and internally reinforced full length with 10- gauge minimum thickness steel channels welded at points not exceeding 3 inches on center inside both door faces. Top and bottom door edges shall be closed with continuous recessed 10-gauge channels extending the full width of the door and welded to the vertical door edge to form a single perimeter frame inside the door. No edge shall be visible.

D. Clearances between doors and frames shall not exceed 1/8 inch (3.2 mm) at jambs, heads, and between pairs of doors. Not more than 1/4 inch (6.4 mm) at bottoms with thresholds or 3/4 inch (19 mm) without thresholds. Doors may be further undercut if so scheduled.

E. Door edges shall be mortised and accurately cut, reinforced, drilled, and tapped to receive templated specified hardware in accordance with the approved hardware schedule and the hardware manufacturer's recommendations for the proper installation of all hardware arid detention equipment.

F. A reinforced pocket shall be provided in each door scheduled to receive mortised locks. The lock shall be protected on each side by a minimum 3/16 inch thick steel plate welded inside the door frames.

G. For locks installed through the edge of the door, provide minimum 3/16 inch thick reinforcing seats, drilled and tapped, set back to the thickness of the face of the lock, and securely welded inside the edge channels. The lock edge reinforcing channel shall not be cut away more than necessary to pass the lock. Lock centering clips shall be provided on each side of the lock pocket and the faces of the door cut out as necessary to pass cylinders, knobs, spindles, etc.

H. The hinge edge reinforcing channel shall not be cut out more than necessary to pass mortise butts where required. An additional 3/16 inch by 1-1/2 inch by 10 inch offset reinforcing plate, drilled and tapped to receive mortise template hinges, shall be securely' welded inside the channel at each butt location. Each reinforcing plate shall have at least one fillet weld across each end in addition to two spot welds. The top hinge reinforcing preparation shall be additionally braced by a channel welded to the back of the hinge reinforcing plate and inside the edge reinforcing channel at each door face.

I. Reinforcing plates, not less than 3/8 inch by 1-1/2 inch by 10 inches shall be welded inside the door face for pull reinforcing.

J. Minimum 12-gauge reinforcing shall be provided, welded inside the door faces for all other surfaced hardware items.

K. Vision and food-pass openings in detention doors shall be framed inside the door with not less than 12-gauge steel channels welded to both faces. Glazing beads shall be factory drilled for TORX pin button head machine screws spaced for glass and glazing scheduled.

L. Sliding doors shall be of detention type construction, as specified herein, reinforced at the top to receive hangers and prepared at the edges and bottom as required by the hardware manufacturer for guides and locking mechanism. Provide the following support structure and guide rails for all sliding doors:
   1. Track mounting plate to be 3/16-inch steel.
   2. Housing cover to be 10-gauge steel.
   3. ½-inch by ¾-inch steel bar track and adjustable door stop.
   4. 3-3/4-inch steel roller doors.
   5. Door hanger.
   6. Masonry type steel plate floor track.
   7. Steel floor guide rail.
   8. Exposed fasteners to be security type spanner head screws.
   9. All other items necessary for a complete and finished installation.
   10. Provide for remote release system wired back to the control room.

M. Food passes are not provided.

2.5 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designing finishes.

B. Covers shall be chemically cleaned and pretreated; then, finished with:
   1. Acrylic urethane custom color as selected by Architect.

C. Protect finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.

D. Variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data including product technical bulletins and installation instructions.

3.2 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions have been previously installed under other sections, and are acceptable for product installation in accordance with manufacturer's instructions. Openings shall be plumb, square and within allowable tolerances. The Architect shall be notified of any conditions that jeopardize the integrity of the proposed door framing system. Do not proceed until such conditions are corrected.

3.3 INSTALLATION

A. Installation shall be by a licensed contractor and in strict accordance with the approved shop drawings.

B. Setting Anchorage Devices:
   1. Provide specified or indicated anchorage devices where required for securing hollow metal frames to in-place construction.
   2. Set anchorage devices opposite each anchor location, in accordance with details on final shop drawings and anchorage device manufacturer's instructions. Leave drilled holes rough, not reamed, and free from dust and debris. Loose anchorage devices shall be furnished with each frame in proper quantity and temporarily secured to inside of frame with heavy duty tape or light gauge wire.

C. Placing Frames:
   1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
   2. Make field splices in frames as detailed on final shop drawings, welded and finished to match factory work.
   3. Remove spreader bars only after frames or bucks have been properly set and secured.

D. Adjustments: Check and readjust operating hardware items just prior to final inspection, leaving steel doors and frames undamaged and in complete and proper operating condition Remove and replace defective work including doors or frames which are warped, bowed, or otherwise unacceptable.

E. Integration: Check and coordinate with owner's IT provider to connect and integrate remote release system to the controller.

3.4 CLEANING AND PROTECTION

A. Protect glass from contact with contaminating substances resulting from construction operations. Remove such substances by method approved by manufacturer.

B. Wash glass on both faces not more than four days prior to date schedule for inspections intended to establish date of Substantial Completion. Wash glass by method recommended by glass manufacturer.

C. Remove temporary coverings and protection of adjacent work areas.

D. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 08 32 00

SECTION 08 33 23 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.1 SUMMARY

A. Section Includes:

1. Insulated rolling service doors,

Related Requirements:

1. Division 05 Section "Metal Fabrications" for miscellaneous steel supports, door-opening framing and corner guards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and project specific mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
5. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For each type of exposed finish on the following components, minimum 6 inches long:

1. Curtain slats.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Special warranty.

B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years' experience in the fabrication and installation of security closures.

B. Installer Qualifications: Installer Qualifications: Company specializing in performing Work of this section with minimum three years and approved by manufacturer.

1.6 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.7 COORDINATION

A. Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: (3) years from date of Substantial Completion. B.

Finishes Warranty:

1. PowderGuard Zinc Base Coat applied to guides, bottom bar, headplates plus PowderGuard Premium applied to curtain and top coat for guides, bottom bar, headplates.
2. Warranty Period: (4) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Location, provide two coiling doors at the sally port.

B. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling-door manufacturer.

C. Basis-of-Design Product: Subject to compliance with requirements, provide “Model 625” by Overhead Door Corporation or a comparable product by one of the following manufacturers, but not limited to:
1. Overhead Door Corporation
2. Cornell Iron Works.
3. C.H.I. Overhead Doors.
4. Or approved equal

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:

1. Design Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward.
2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

B. Operation: Design door assembly, including operator, to operate for not less than 50,000 cycles.

2.3 DOOR ASSEMBLY

A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Endlocks shall be attached to each end of alternate slats to prevent lateral movement.

1. Wall Mounting Condition: Face-of-wall mounting. B.

Performance:

1. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
2. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E283.
3. Insulated Door Curtain R-Value: 7.7 deg F x h x sq. ft./Btu .
4. Through Curtain Sound Rating: Sound Rating: STC-28 (STC-30+ with HZ noise generator) as per ASTM E 90.
5. Installed System Sound Rating: STC-21 as per ASTM E 90. C. Door Curtain Slats: Flat profile slats.
6. Galvanized Steel: 24 gauge (0.0239 inch); thick, hot-dip galvanized-steel sheet with G90 (Z275) zinc coating, complying with ASTM A653/A653M.
7. Insulation: CFC-free foamed-in-place, polyurethane insulation.

    a. Maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723.
    b. Enclose insulation completely within slat faces.

C. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with nominal sheet thickness (coated) of 24 gauge (0.0239 inch); and as required.

D. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

D. Weatherseals: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

1. Air infiltration perimeter seal package includes: guide cover, guide cap, dual brush exterior guide seal, 4 inch finned lintel brush seal and vinyl bottom seal.

E. Bottom Bar: (2) prime painted steel angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch, bolted back-to-back to reinforce curtain in the guides. F. Guides: (3) galvanized structural steel angles.

G. Brackets: Hot rolled prime painted steel to support counterbalance, curtain and hood.

H. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to 0.03 inch per foot of span.

1. Counterbalance is adjustable by means of an adjusting tension wheel.

I. Hood: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Equip hood with intermediate support brackets as required to prevent sagging.

1. Provide with internal hood baffle weatherseal.
2. Galvanized Steel: 24 gauge (0.0239 inch); thick, hot-dip galvanized-steel sheet with G90 (Z275) zinc coating, complying with ASTM A653/A653M.
3. Shape: Square.
4. Mounting: Face of wall.

J. Locking Devices: Equip door with slide bolt for electric operation with interlock switch.

1. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
2. Chain Lock Keeper: Suitable for padlock.
3. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked. K. Electric Door Operator:

1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
2. Operator Location: Front of hood.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. or lower.
4. Motor Exposure: Interior.
5. Motor Electrical Characteristics:

   a. Horsepower: Size as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second.

   b. Voltage: 115 or 230 V ac, single phase, 60 Hz.

6. Emergency Manual Operation: Chain type.

7. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar.

   a. Sensor Edge Bulb Color: As selected by Architect from manufacturer's full range.

8. Control Stations: Interior mounted. Push-button operated control stations with open, close, and stop buttons L. Finishes:

1. Slats and Hood Finish: Slats and hood galvanized and receive rust-inhibitive, roll coating process, including 0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on polyester top coat.

   a. Powder-Coated Finish: ‘PowderGuard Premium’ color as selected by Architect from manufacturer's full range.
   b. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2. Bottom Bar, Guides, Headplate and Brackets Finish:

   a. ‘PowderGuard Zinc’ base coat with ‘PowderGuard Premium’ color as selected by Architect from manufacturer's full range.

2.4 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): Operator location indicated for each door.

1. Front-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.

1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at

   a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.

1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with generalpurpose NEMA ICS 6, Type 1 enclosure.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 STEEL AND GALVANIZED-STEEL FINISHES

A. Powder-Coat Finish: Manufacturer's standard finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness. Architect to secle from standard color line.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work. B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION, GENERAL

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.

D. Power-Operated Doors: Install according to UL 325.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.5 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

1. Adjust exterior doors and components to be weather resistant.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.6 CLEANING

A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.

B. Remove labels and visible markings.

C. Touch-up, repair or replace damaged products before Substantial Completion.

3.7 PROTECTION

A. Protect installed products until completion of project.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 08 33 23

SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.1 SUMMARY

A. Section Includes:

1. Interior and exterior storefront framing.
2. Interior and exterior manual-swing entrance doors.

1.2 REFERENCE SPECIFICATIONS

A. 08 43 33 BULLET RESISTANT ALUMINUM STOREFRONT

B. 08 43 33.13 SECURITY STOREFRONT BULLET RESISTANT ALUMINUM FRAMING & DOORS

C. 08 80 00 GLAZING

1.3 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. LEED Submittals:
1. Comply with Section 01 81 13:
   a. MR Credit 2: BPDO – Environmental Product Declarations (EPD): For each product.
   b. MR Credit 3: BPDO – Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

c. MR Credit 4: BPDO – Material Ingredient Reports and/or Material Ingredient Optimization Reports and Action Plans.
   1) Health Product Declaration (HPD): For each product.

C. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
3. Include point-to-point wiring diagrams.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.

C. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AGM) contractors.

B. Product Options: Information on Drawings and Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.
e. Failure of operating components.

2. Warranty Period: 2 years from date of Substantial Completion.

B. Special Finish Warranty: Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Provide glazed aluminum curtain-wall systems, including anchorage, capable of withstanding, without failure, the effects of the following:

1. Structural loads.
2. Thermal movements
3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
4. Dimensional tolerances of building frame and other adjacent construction.
5. Failure includes the following:

a. Deflection exceeding specified limits.
b. Thermal stresses transferred to building structure.
c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
d. Noise or vibration created by wind and thermal and structural movements.
e. Loosening or weakening of fasteners, attachments, and other components.
f. Sealant failure.

B. Structural Loads:
1. As indicated on the structural drawings.

C. Structural-Test Performance: Systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Duration: As required by design wind velocity but not less than 60 seconds.

D. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.

2. Cantilever Deflection: Where framing members overhang an anchor point, limited to 2 times the length of cantilevered member, divided by 175.

E. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Fixed Framing and Glass Area:

a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.

2. Entrance Doors:

a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
b. Single Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.

F. Energy Performance for exterior assemblies: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall be thermally broken and have maximum u-factor of 0.32 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Thermal Transmittance (U-factor): Entrance doors shall be thermally broken and have a maximum Sytem u-factor of 0.5 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
3. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient (SHGC) of maximum 0.35 as determined according to NFRC 200.
4. Condensation Resistance Factor for Fixed glazing and framing areas: The glass to exterior CRF, when tested to AAMA Specification 1503, shall be 70 (frame) and 69 (glass) minimum.
5. Condensation Resistance Factor for exterior Entrance doors: when tested to AAMA Specification 1503, the CRF shall be 49 (frame) and 68 (glass) minimum.

G. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

2.2 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include the following:

1. Kawneer Company, Inc.
2. EFCO Corporation.
3. YKK AP America Inc.
4. Oldcastle Building Envelope.

B. Basis-of-Design Products: Kawneer Company, Inc.

1. Exterior Framing: Trifab VG 451T Storefront System, Size: 2” x 4 1/2”
2. Interior Framing: Trifab 400, Size: 1 ¾” X 4”
3. Exterior Doors: 500T wide stile Insulpour Thermal door with 10” bottom rail
4. Interior Doors: 500 wide stiles with 10” bottom rail

C. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken exterior, non-thermal interior.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Center.
4. Finish: Anodic Finish – Clear Anodized.
5. Fabrication Method: Shop-assembled, Field-fabricated stick system.

B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

a. Sheet and Plate: ASTM B 209.
b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
d. Structural Profiles: ASTM B 308/B 308M.

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. NOTE, SEE BALLISTIC

2. Door Construction: 2-1/4-inch or 1-3/4-inch overall thickness, with minimum 0.125-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
3. Door Design: Wide stile; 5-inch nominal width.
4. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.

2.5 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Division 8 "Door Hardware."

B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:

a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.
b. Accessible Interior Doors: Not more than 5 lbf to fully open door.

C. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

D. Continuous-Gear Hinges: Manufacturer's standard with stainless-steel bearings between knuckles, fabricated to full height of door and frame.

E. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.

F. Manual Flush Bolts: BHMA A156.16, Grade 1.

G. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

H. Cylinders: As specified in Division 8 "Door Hardware".

I. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

J. Operating Trim: BHMA A156.6.

K. Removable Mullions: BHMA A156.3, extruded aluminum.

1. When used with panic exit devices, provide removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.

L. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.

M. Concealed Overhead Holders: BHMA A156.8, Grade 1.

N. Surface-Mounted Holders: BHMA A156.16, Grade 1.

O. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

P. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

Q. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

R. Silencers: BHMA A156.16, Grade 1.

S. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch

2.6 GLAZING

A. Glazing: Comply with Division 8 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

1. Verify sealant has a VOC content of 250 g/L or less.
2. For sealants, indicating compliance with requirements for low-emitting materials.

2.7 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

B. Anchors: Adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.8 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.
2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM DOOR FINISHES

A. Fluoropolymer Three Coat Coating System: Manufacturer's standard three coat, thermo-cured system composed of specially formulated inhibitive primer, fluorocarbon color coat, and a clear fluorocarbon topcoat (applicable with three coat system). Both color coat and clear topcoat shall contain not less than 70% polyvinylidene resin by weight in compliance with AAMA 2605 for testing, performance, and application procedures.

1. Panels shall be chemically etched by an appropriate cleaner in accordance with manufacturer's written instructions.

2. Apply acid resistant primer to cleaned aluminum. Thickness range; 0.20 to 0.30 mils.

3. Apply polyvinylidene fluoride (PVF2) resinated color coat. Thickness range; 0.8 to 1.2 mils.
   a. Kynar 500. Must be applied by certified Kynar coater.

4. Apply clear top coat finish as extra protection, no less then 0.8 mils thick. Comply with AAMA standards.
5. Color: Custom color to match architect's sample, or if none, from manufacturer's standard selection

2.10 ALUMINUM FRAME FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

B. Anodized Finishing: Prepare aluminum surfaces for specified finish; apply shop finish in accordance with the following:
1. Anodic Coating: Electrolytic color coating followed by an organic seal applied in accordance with the requirements of AAMA 612. Aluminum extrusions shall be produced from quality controlled billets meeting AA-6063-T5.
2. Exposed Surfaces shall be free of scratches and other serious blemishes.
3. Extrusions shall be given a caustic etch followed by an anodic oxide treatment and then sealed with an organic coating applied with an electrodeposition process.
4. The anodized coating shall comply with all of the requirements of AAMA 612: Voluntary Specifications, Performance Requirements and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum. Testing

shall demonstrate the ability of the finish to resist damage from mortar, salt spray, and chemicals commonly found on construction sites, and to resist the loss of color and gloss
5. Overall coating thickness for finishes shall be a minimum of 0.7 mils

C. Finishes Testing:
1. Apply 0.5% solution NaOh, sodium hydroxide, to small area of finished sample area; leave in place for sixty minutes; lightly wipe off NaOh; Do not clean area further.
2. Submit samples with test area noted on each sample.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Division 8 "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.3 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet
3. Alignment: limit offset from true alignment to 1/16 inch.
4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.4 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

END OF SECTION 08 41 13

SECTION 08 43 33 - BULLET-RESISTANT ALUMINUM STOREFRONTS

PART 1GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.1 SUMMARY

A. Section Includes:
   1. Bullet-resistant aluminum storefront assemblies.
   2. See 08 43 33.13 SECURITY STOREFRONT BULLET RESISTANT ALUMINUM FRAMING AND DOORS for ballistic door and frame system.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. American Architectural Manufacturers Association (AAMA):
   1. 611 - Voluntary Specification for Anodized Architectural Aluminum.
   2. 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Architectural Extrusions and Panels.

B. American Society of Civil Engineers (ASCE) 7 - Minimum Design Loads for Buildings and Other Structures.

C. American Welding Society (AWS) D1.2/D1.2M - Structural Welding Code - Aluminum.

D. ASTM International (ASTM) (www.astm.org):
   1. B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   2. C509 - Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
   3. C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
   4. E283 - Standard Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors.
   5. E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors under the Influence of Wind Loads.
   6. E331 - Standard Test Method for Water Penetration of Exterior Windows, Doors, and Curtain Walls by Uniform Static Air Pressure Differential.

E. Federal Emergency Management Agency (FEMA) 361 - Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms.

F. Underwriters Laboratories (UL) 752 - Bullet Resisting Equipment.

G. US General Services Administration (GSA) P-100 - Facilities Standards for the Public Buildings Service.

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Design Exterior & Interior systems to withstand:
1. Design wind pressure in accordance with IBC 2018 with maximum allowable deflection of L/175, tested in accordance with ASTM E330.
2. Movement caused by an ambient temperature range of 120 degrees F and a surface temperature range of 160 degrees F.

B. Performance Requirements:
1. Air infiltration: Maximum 0.06 CFM per square foot of fixed area at static pressure differential of 6.24 PSF tested to ASTM E283.
2. Water infiltration: No uncontrolled water leakage, tested to ASTM E331 at minimum test pressure of 12.0 PSF.
3. Uniform structural loading: No glass breakage or permanent damage to fasteners or system components, tested to ASTM E330 at 1.5 times design pressure.

1.4 SUBMITTALS

A. Submittals for Review:
1. Shop Drawings: Include frame profiles and sizes, type and spacing of frame anchors, reinforcement size and locations, details of joints and connections, and welding details.
2. Product Data: Include product description for storefront assemblies including bullet-resistant rating.
3. Samples: [2 x 2]] inch coating samples in specified color.

B. Closeout Submittals:
1. Maintenance Data: Include instructions for cleaning of glazed panels.

1.5 QUALITY ASSURANCE

A. Storefront Assemblies:
1. Ballistic Level 3, & 5, tested to UL 75, see drawings and glazing types
2. GSA P-100, Classifications C Blast Resistant.
3. Rated to FEMA 361.

1.6 DELIVERY, STORAGE AND HANDLING

A. Do not cover with non vented coverings that create excessive humidity.

B. Remove wet coverings immediately.

1.7 ALTERNATES

A. Add Alternate No. 1: The Amount to be added to the total contract sum in connection with increasing the base bid level 3 ballistic ratings at the first-floor exterior storefront system and glazing to level 5 ballistic rating, as shown on the architectural drawings.

B Add Alternate No. 2: The Amount to be added to the total contract sum in connection with providing level 5 ballistic rated storefront system and glazing to all second floor Type W-1 windows in lieu of the GL-1 glazing.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Model TH600 by ARMORTEX, 5926 Corridor Parkway, Schertz, Texas, 800-880-8306, www.armortex.com.

B. For up to Level 3 ballistic glazing: Basis of Design: McGrory BallisticDefend Unico Bullet Resistant Framing and Doors by McGrory Glass; Phone 800.220.3749; website www.mcgrory.com

C. Substitutions: [Under provisions of Division 01.] [Not permitted.]

2.2 MATERIALS

A. Aluminum Extrusions:
1. ASTM B221, 6061-T6 alloy and temper; minimum 38.0 KSI ultimate tensile strength and minimum 35.0 KSI yield strength.

2.3 ACCESSORIES

A. Internal Fasteners: Type 18-8 stainless steel.

B. Interior Glazing Gaskets: ASTM C509, Type II, Option 1 and ASTM C864; closed cellular neoprene, 40 to 50 Shore A durometer.

C. Exterior Glazing Gaskets: ASTM C864; solid neoprene, 65 to 75 Shore A durometer.

D. Glazing: Accept 1-1/4 to 2-1/16 inch thick glazing materials.

2.4 FABRICATION

A. Fabricate frames from extruded aluminum with 2-1/2 inch face width x 6 inch overall depth.

B. Fabricate with tight joints and connections providing hairline joints and true alignment of adjacent members.

C. Glazing not removable from threat side of assembly.

D. Welding: In accordance with AWS D1.2/D1.2M. Grind exposed welds flush and smooth.

2.5 FINISHES

A. Aluminum: AAMA 611, Architectural Class I anodized, clear.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install door and frame assemblies in accordance with manufacturer’s instructions and approved Shop Drawings.

B. Set plumb, square, and level.

C. Secure to adjacent construction using fastener type best suited to application.

D. Field alterations to door and frame assemblies other than drilling and tapping for surface-mounted hardware not permitted unless approved in advance by manufacturer and Architect.

3.2 ADJUSTING

A. Touch up minor scratches and abrasions to match factory finish.

END OF SECTION

SECTION 08 43 33.13 – SECURITY STOREFRONT BULLET RESISTANT ALUMINUM FRAMING AND DOORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.1 SECTION INCLUDES

A. Bullet Resistant Aluminum Storefront Framing and Entrance Doors.

B. Bullet Resistant Glazing (insulated & non-insulated).

1.2 ACTION SUBMITTALS

A. Refer to Section 01 33 00 Submittal Procedures.

B. Product Data: For each type of framing and glazing including manufacturer recommended installation instructions.

C. Shop Drawings: Include plans, elevations, sections, details, attachment to other work and glazing details for field-glazed units.

D. Samples: For each exposed finish.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Indicating compliance with requirements.

B. Warranty: Sample of finish warranty

1.4 CLOSEOUT SUBMITTALS

A. Refer to Section 01 78 00 Closeout Submittals.

B. Maintenance data.

1.5 QUALITY ASSURANCE

A. Mock-up: Install framing assembly at project site. Obtain Architect's approval prior to proceeding with installation of remaining storefront. Accepted mock-up may remain as portion of final work.

1.6 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 01 60 00 Product Requirements.

1.7 WARRANTY

A. Finish Warranty: Manufacturer's warranty against deterioration of factory finishes for the period of 5 years from the date of Substantial Completion.

B. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 5 years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 5 years from date of Substantial Completion.

D. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 5 years from date of Substantial Completion.

1.8 ALTERNATES

A. Add Alternate No. 1: The Amount to be added to the total contract sum in connection with increasing the base bid level 3 ballistic ratings at the first-floor exterior storefront system and glazing to level 5 ballistic rating, as shown on the architectural drawings.

B Add Alternate No. 2: The Amount to be added to the total contract sum in connection with providing level 5 ballistic rated storefront system and glazing to all second floor Type W-1 windows in lieu of the GL-1 glazing.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Basis of Design: Insulgard HP600/ HP500 Bullet and Resistant Architectural Aluminum Framing and Doors by Insulgard Security Products; Phone 800.624.6315; website www.insulgard.com,

B. Basis of Design: McGrory BallisticDefend Unico Bullet Resistant Framing and Doors by McGrory Glass; Phone 800.220.3749; website www.mcgrory.com

1. Subject to compliance with requirements, manufacturers of products of equivalent design may be acceptable if approved in accordance with Section 01 25 00 Substitution Procedures.

C. Description

1. Factory fabricated framing constructed from either 6105-T5 or 6005-T5 extruded aluminum with integral weep design to allow water to vent to the exterior along horizontal members.
2. Dimensions:

a. Head, Jamb, Sill, Mullion and Intermediate Horizontal Members: 2-1/2 inches by 6 inches.
b. Doors: Bottoms - 10”x3 5/8”, stiles and top rail – 5”x3 5/8”.

2.2 PERFORMANCE CRITERIA

A. Ballistic Resistant: Level 3 & Level 5 in accordance with UL 752 – Testing for Ballistic Resistance for the complete assembly including framing, glazing and panels.

2.3 FABRICATION

A. Tolerances: All joints and connections shall be tight, providing hairline joints and true alignment of adjacent members

2.4 ALUMINUM FRAME FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

B. Anodized Finishing: Prepare aluminum surfaces for specified finish; apply shop finish in accordance with the following:

1. Anodic Coating: Electrolytic color coating followed by an organic seal applied in accordance with the requirements of AAMA 612. Aluminum extrusions shall be produced from quality controlled billets meeting AA-6063-T5.
2. Exposed Surfaces shall be free of scratches and other serious blemishes.
3. Extrusions shall be given a caustic etch followed by an anodic oxide treatment and then sealed with an organic coating applied with an electrodeposition process.
4. The anodized coating shall comply with all of the requirements of AAMA 612: Voluntary Specifications, Performance Requirements and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum. Testing shall demonstrate the ability of the finish to resist damage from mortar, salt spray, and chemicals commonly found on construction sites, and to resist the loss of color and gloss
5. Overall coating thickness for finishes shall be a minimum of 0.7 mils

C. Finishes Testing:
1. Apply 0.5% solution NaOh, sodium hydroxide, to small area of finished sample area; leave in place for sixty minutes; lightly wipe off NaOh; Do not clean area further.
2. Submit samples with test area noted on each sample.

2.5 ALUMINUM DOOR FINISHES

A. Fluoropolymer Three Coat Coating System: Manufacturer's standard three coat, thermo-cured system composed of specially formulated inhibitive primer, fluorocarbon color coat, and a clear fluorocarbon topcoat (applicable with three coat system). Both color coat and clear topcoat shall contain not less than 70% polyvinylidene resin by weight in compliance with AAMA 2605 for testing, performance, and application procedures.

1. Panels shall be chemically etched by an appropriate cleaner in accordance with manufacturer's written instructions.

2. Apply acid resistant primer to cleaned aluminum. Thickness range; 0.20 to 0.30 mils.

3. Apply polyvinylidene fluoride (PVF2) resinated color coat. Thickness range; 0.8 to 1.2 mils.
   a. Kynar 500. Must be applied by certified Kynar coater.

4. Apply clear top coat finish as extra protection, no less then 0.8 mils thick. Comply with AAMA standards.
5. Color: Custom color to match architect's sample, or if none, from manufacturer's standard selection

2.6 Ballistic Glazing

1. GL-3 2.010" Nom. Thickness Insulated Level 5 ballistic glazing SEE 08 43 44.13
   a. Basis of Design: Baluln32 IG, by Insulgard Security products
   b. Thickness: 2.010" Nom.
   c. Light Transmittance: 68%
   d. U-Value: 0.42
   e. SHGC: 0.62
   f. Shading Coefficient: 0.71

2. GL-4 1.717" Nom. Thickness Insulated Level 3 ballistic UL 752SEE 08 43 44.13
   a. Basis of Design: Baluln25 IG, by Insulgard Security products
   b. Thickness: 1.742" Nom.

c. Light Transmittance: 69%
d. U-Value: 0.43
e. SHGC: 0.62
f. Shading Coefficient: 0.71

3. GL-8
   a. Basis of Design: Baluln25, by Insulgard Security products
   b. Thickness: 1.01” Nom.
   c. Light Transmittance: 77%
   d. U-Value: 0.84
   e. SHGC: 0.63
   f. Shading Coefficient: 0.72

4. Allowable Tolerances: Plus or minus 1/4 inch for frame opening width, height, diagonal dimensions, and overall width and height (outside to outside).

2.7 ACCESSORIES

A. Anchors: Fully concealed in accordance with requirements of delegated design requirements

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify field dimensions of opening prior to fabrication of windows.

B. Coordinate structural requirements to ensure proper attachment and support.

3.2 INSTALLATION

A. Install windows in accordance with manufacturer's recommendations and approved shop drawings.

B. Provide required support and securely fasten and set windows plumb, square, and level without twist or bow.

C. Apply sealant in accordance with window and sealant manufacturer's recommendations as indicated in installation instructions. Wipe off excess, and leave exposed sealant surfaces clean and smooth.

3.3 PROTECTION

A. Clean and protect windows from damage during construction operations. If damage occurs, remove and replace as required to provide windows in their original, undamaged condition.

END OF SECTION 08 43 33.13

SECTION 08 45 13 - STRUCTURED-POLYCARBONATE-PANEL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. Section includes aluminum-framed assemblies glazed with translucent polycarbonate panels as follows:

1. Translucent unit panel wall system. Or

2. Translucent wall panel.

1.3 PREINSTALLATION MEETING

A. Discussion topics should include the following: schedule; sequence; coordination of trades; substrate review and acceptance; protection; shop drawings and submittals; interface conditions and details; environmental constraints; mockups; testing requirements; field quality control efforts. Meetings shall be attended by owner, construction manager, sub-contractor, architect, engineers, etc. at the job site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum components of panel assemblies.

B. Shop Drawings: For panel assemblies.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.
3. Shop drawings shall include project-specific interface conditions and depict integration with adjacent exterior wall conditions.

C. Samples: In manufacturer's standard size.

1. For each type of structured-polycarbonate panel.
2. For each type of exposed finish for framing members.

D. Fabrication Samples: Of each framing system intersection and adjacent panels, made from 12-inch (305-mm) lengths of full-size framing members and showing details of the following:

1. Joinery.
2. Anchorage.
3. Expansion provisions.
4. Translucent polycarbonate panels.
5. Flashing and drainage.

E. Submittal: For panel assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each translucent polycarbonate-panel assembly, for tests performed by a qualified testing agency.

C. Evaluation Reports: For translucent polycarbonate-panel assemblies from ICC-ES.

D. Field quality-control reports.

E. Sample Warranties: For special warranties.

F. Manufacturer’s installation instructions.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For panel assemblies to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical panel assemblies as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of panel assemblies that fail in materials or fabrication workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
c. Water leakage.

2. Warranty Period: Five years from date of Substantial Completion.

B. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace translucent polycarbonate panels that exhibit defects in materials or workmanship within specified warranty period.

1. Defects include, but are not limited to, the following:

a. Delamination.
b. Color changes exceeding requirements.
c. Losses in light transmission beyond 6 percent from original when measured after 10 years according to ASTM D 1003.

2. Warranty Period: 10 years from date of Substantial Completion.
3. Warranty Period for Hail Damage: Five years from date of Substantial Completion for hail stone penetration exceeding requirements.

C. Special Aluminum-Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

1. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.
2. Warranty Period: 10 years from date of Substantial Completion.

D. Installer's Warranty: Installer agrees to repair or replace components of panel assemblies that fail in installation workmanship within specified warranty period.

1. Failures include, but are not limited to, installation defects and water leakage.
2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design translucent polycarbonate-panel assemblies.

B. Structural Loads: As indicated on Drawings.

C. Deflection Limits:

1. Vertical Panel Assemblies: Limited to 1/120 of clear span for each assembly component of aluminum framing and panel joint according to the IBC, Table 1604.3 for exterior walls with flexible materials.
2. Overhead Panel Assemblies: Limited to 1/60 of clear span for each assembly component of aluminum framing and panel joint according to the IBC, Table 1604.3, footnote h.

D. Structural-Test Performance: Panel assemblies tested according to ASTM E 330, as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not show evidence of deflection exceeding specified deflection limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not show evidence of material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Windborne-Debris-Impact-Resistance Performance: Panel assemblies that pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and the testing information in ASTM E 1996 for Wind Zone 2.

1. Large-Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazed openings located more than 30 feet (9.1 m) above grade.

F. Hail-Stone Impact Resistance: Panel assemblies that resist penetration by hail stone smaller than 1-3/16 inches (30 mm) in diameter, impacting panel surface at a final velocity up to 44 fps (13.4 m/s) per ASTM E 822.

G. Panel Clip Performance: Corrosion-resistant clips tested to meet a minimum 90-lb/sq. ft. (4.3-kPa) wind uplift when tested according to ASTM E 330.

H. Panel End Seals: Continuous factory-applied, self-adhered micro-filter tape over open panel cells and factory heat-seal-crimped open panel cells.

I. Panel Performance:

1. Smoke-Developed Index: 450 or less according to ASTM E 84, or 75 or less according to ASTM D 2843.
2. Flame Spread: 25 or less when tested according to ASTM E 84.
3. Combustibility Classification: Class CC1 based on testing according to ASTM D 635.
4. Interior Finish Classification: Class A based on testing according to ASTM E 84.
5. Visible Light Transmittance (VT) Loss: 6 percent maximum over 10 years, measured according to ASTM D 1003.
6. Thermal Aging: When exposed to 300 deg F (149 deg C) for 25 minutes, interior and exterior panels tested according to ASTM D 2244.

    a. Color Retention: 0.75 (Hunter) units ΔE maximum fade.
    b. Color Darkening: 0.3 (Hunter) units ΔL maximum.
    c. Cracking or Crazing: None when exposed to 300 deg F (149 deg C) for 25 minutes.
    d. Delamination: None when exposed to 300 deg F and 0 deg F (plus 149 and minus 17.8 deg C) for 25 minutes.

7. Impact Resistance: No failure at an impact of 500 lbf (677.9 Nm) when tested according to ASTM E 695.
8. Concentrated Loading: No damage while applying a load of 600 lbf (813.5 Nm) over 1 sq. ft. (0.093 sq. m.) when tested according to 29 CFR 1910.23(e)(8); and no damage while applying a load of 400 lbf (542.3 Nm) over 3 inches (152 mm) in diameter according to ASTM E 661.
9. Basis of Design NFRC Requirements:
    a. CPD#: KLA-M-5-00001-00005
    b. U-factor: 0.29 maximum
    c. SHGC: 0.23 maximum
    d. VT: 0.10 minimum
    e. Condensation Resistance: 40 minimum
    f. Anodized: M006.5 10mm UQ(white Matte)|10mm UQ(White Matte)

J. Water Penetration under Static Pressure: Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

K. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

L. Energy Performance: Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below and certified and labeled according to NFRC.

1. Thermal Transmittance (U-Factor): Fixed panel and mill finish aluminum framing whole assemblies shall have U-factor of not more than 0.29 Btu/sq. ft. x h x deg F (1.59 W/sq. m x K) vertical application and 0.31 Btu/sq. ft. x h x deg F (1.76 W/sq. m x K) sloped application as determined according to NFRC 100.
2. Solar-Heat-Gain Coefficient (SHGC): Panel assembly shall have an SHGC of no greater than 0.23 as determined according to NFRC 200.
3. Visible Light Transmittance (VT): White Matte, 0.10 or greater according to NFRC 202; White matte 0.10, according to ASTM E 972, ASTM E 1084.
4. Air Infiltration: Maximum air leakage through fixed glazing and skylight framing assemblies of 0.30 cfm/sq. ft. (1.50 L/s per sq. m) of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
5. Air Infiltration: Maximum air leakage through fixed window glazing and framing assemblies of 0.20 cfm/sq. ft. (1.02 L/s per sq. m) of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
6. Air Infiltration: Maximum air leakage through fixed curtain wall and storefront glazing and framing assemblies of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

2.2 TRANSLUCENT POLYCARBONATE-PANEL ASSEMBLIES

A. Translucent Polycarbonate-Panel Assemblies: Translucent assemblies that are supported by aluminum framing and glazed with translucent polycarbonate panels.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Kingspan; UniQuad or an approved equal product by one of the following:

a. Wasco by Velux LumiWal System
b. Kalwall

2.3 TRANSLUCENT POLYCARBONATE WALL PANELS

A. Translucent, Multiwall Cellular Polycarbonate Panel Thermally Broken Assembly: Consisting of two independent, multiwall cellular cross-section, polycarbonate glazing panels with air-insulated spaces and coextruded UV protection, integrated into a panel assembly with concealed metal connecters consisting of a two-piece male/female battens with built-in silicone gaskets. Unitized panel assembly shall be incorporated into a complete aluminum frame system without exposed mullions. Design panels for exterior panel replacement, independent of interior single panel and without exposing the interior, or compromising weather-tightness, or interfering with the normal working functions of the building.

B. Panel Thickness: Overall assembly minimum 4 inch (102 mm).

C. Perimeter Frame Thermal Break: 0.25-inch- (6.4-mm-) minimum, poured and debridged separation consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum framing.

D. UV Resistance: Coextruded on weather-exposed surfaces during glazing panel manufacture.

E. Color: As selected by Architect from manufacturer's full range.

F. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

1. Sound Transmission Class (STC): Paired-panel assemblies shall have a minimum overall acoustic value of the following STC:
a. Paired-Panel Assembly; 4 Inches (101 mm) Thick: STC 26.

G. Department of Defense Forced Entry Resistance: Provide "5-Minute-Forced-Entry" certification according to Department of State, SD-STD-01.01, Revision G (Amended), Code 2114 according to UFC 4-020-1, "DOD Security Engineering Planning Manual."

H. Department of Defense Antiterrorism Standard for Buildings: Provide stamped calculations for Project-specific conditions showing compliance according to UFC 4-010-01.

I. Human-Impact Resistance: For human-impact-resistant assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 695; shall withstand impact loading by blunt object of 2000 ft.-lb (271 Nm).

J. Panel Performance:

1. Color Retention: 3.0 (Hunter) units ΔE, maximum fade as measured according to ASTM D 2244 when tested on minimum of two white color samples after panels have weathered outdoors in Arizona with panels exposed to a minimum 36.78 Langleys (1540 MJ/sq. m).
2. Haze Factor: Greater than 90 percent when tested according to ASTM D 1003.

2.4 ALUMINUM FRAMING SYSTEMS

A. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.

B. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
3. Extruded Structural Pipe and Tubes: ASTM B 429 (/B 429M).
4. Structural Profiles: ASTM B 308 (/B 308M).

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.

D. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.

1. At closures, retaining caps, or battens, use ASTM A 193 (/A 193M), 300 series stainless-steel screws.
2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.

E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 (/A 123M) or ASTM A 153 (/A 153M) requirements.

F. Anchor Bolts: ASTM A 307, Grade A, galvanized steel.

G. Concealed Flashing: Corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

H. Exposed Flashing and Closures: Aluminum sheet not less than 0.040-inch (1.02-mm) thick, finished to match framing.

I. Framing Gaskets: Manufacturer's standard gasket system with low-friction surface treatment designed specifically for retaining translucent polycarbonate panels.

J. Frame-System Sealants: As recommended in writing by manufacturer.

1. Sealant shall have a VOC content of 250 g/L or less.

K. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

L. White Cover Board over Semi Rigid Insulation, where solid wall.

2.5 FABRICATION

A. Fabricate aluminum components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Internal guttering systems or other means to drain water passing through joints and moisture migrating within assembly to exterior.

B. Fabricate aluminum sill closures with weep holes and for installation as continuous component.

C. Reinforce aluminum components as required to receive fastener threads.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions.

1. Do not install damaged components.
2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
3. Rigidly secure nonmovement joints.
4. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.
5. Seal joints watertight unless otherwise indicated.

B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

C. Install components plumb and true in alignment with established lines and elevations.

D. Skylight Assemblies: Install continuous aluminum sill closures with weatherproof expansion joints and locked and sealed corners. Install components to drain water passing through joints and moisture migrating within assembly to exterior.

E. Erection Tolerances: Install panel assemblies to comply with the following maximum tolerances:

1. Alignment: Limit offset from true alignment to 1/32 inch (0.8 mm) where surfaces abut in-line, edge-to-edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches (76 mm); otherwise, limit offset to 1/8 inch (3.2 mm).
2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3.2 mm in 3.7 m), but no greater than 1/2 inch (12 mm) over total length.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Water-Spray Test: Before installation of interior finishes has begun, panel assemblies shall be tested according to AAMA 501.2 and shall not show evidence of water penetration.
2. Water Penetration under Static Pressure: Before installation of interior finishes has begun, areas shall be tested according to ASTM E 1105.

    a. Test Procedures: Test under uniform and cyclic static-air pressure.
    b. Static-Air-Pressure Difference: As indicated on the drawings.
    c. Water Penetration: None.

B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

END OF SECTION 08 45 13

SECTION 08 56 69 -BULLET-RESISTANT ALUMINUM TRANSACTION WINDOWS

PART 1GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.1 SUMMARY

A. Section Includes:
1. Bullet-resistant fixed aluminum transaction window assemblies.
2. Bullet-resistant baffle type aluminum transaction window assemblies.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.
2. 06 40 23 Interior Architectural Woodwork
3. 08 43 33 BULLET RESISTANT ALUMINUM STOREFRONT
4. 08 43 33.13 SECURITY STOREFRONT BULLET RESISTANT ALUMINUM FRAMING & DOORS
5. 08 80 00 GLAZING

1.2 REFERENCES

A. American Welding Society (AWS) D1.2/D1.2M - Structural Welding Code - Aluminum.

B. American Architectural Manufacturers Association (AAMA) 611 - Voluntary Specification for Anodized Architectural Aluminum.

C. ASTM International (ASTM) B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

D. Underwriters Laboratories (UL) 752 - Bullet Resisting Equipment.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:
1. Provide window frames of "non-ricochet type" intended to permit capture and retention of attacking projectile, lessening potential of random injury or lateral penetration.
2. Two way "natural voice" communication permitted by design of vertical side frames and glazing technique.

1.4 SUBMITTALS

A. Submittals for Review:

1. Shop Drawings: Include window profiles and sizes, type and spacing of frame anchors, reinforcement size and locations, details of joints and connections, and welding details.
2. Product Data: Include product description for window assemblies including bullet-resistant ratings.
3. Samples: 2 x 2 inch coating samples showing available colors.

B. Closeout Submittals:
1. Maintenance Data: Include instructions for cleaning of glazed panels.

1.5 QUALITY ASSURANCE

A. Transaction Window Assemblies: Ballistic Level 3, tested to UL 752. GL-8 per glazing schedule.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store window assemblies upright in protected, dry area, off ground or floor, with at least 1/4 inch space between individual units.

B. Do not cover with non-vented coverings that create excessive humidity.

C. Remove wet coverings immediately.

1.7 ALTERNATES

A. Add Alternate No. 1: The Amount to be added to the total contract sum in connection with increasing the base bid level 3 ballistic ratings at the first-floor exterior storefront system and glazing to level 5 ballistic rating, as shown on the architectural drawings.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Contract Documents are based on products by ARMORTEX, 5926 Corridor Parkway, Schertz, Texas, 800-880-8306, www.armortex.com.

2.2 MATERIALS

A. Aluminum Extrusions:
1. ASTM B221, 6061-T6 alloy and temper; minimum 38.0 KSI ultimate tensile strength and minimum 35.0 KSI yield strength.

B. Bullet-Resistant Composite: UL Listed Bullet Resistant Composite by ARMORTEX.

C. Glazing:
1. GL-8, Level 3 UL 752 Listed laminated glass.

2. Bottom edge of glazing panel provided with 18 gage stainless steel cap.

D. Track and Hangers:
1. Aluminum track and hangers.

2.3 FABRICATION

A. Frames:
1. Fabricate from aluminum extrusions lined with bullet-resistant composite.
2. Weld frame corners; knock-down and mechanical joints not acceptable.
3. Frame modules capable of being joined with other frame modules to form continuous line.
4. Replacement of glazing from secure side of window, not requiring removal of frame from opening.

B. Deal Tray: Model RMDT1016, 16 gage stainless steel, 10 x 16 inches to outside edge of flanges, clear 1-5/8 inch open depth under glazing. Coordinate with SSM countertop.

C. Provide 1 inch acrylic spacers and stainless steel security screws at baffles.

D. Welding: In accordance with AWS D1.2/D1.2M. Grind exposed welds flush and smooth.

E. Finish work neat and free from defects.

F. Allowable Tolerances: Plus or minus 1/16 inch for frame opening width, height, diagonal dimensions, and overall width and height (outside to outside).

2.4 FINISHES

A. Aluminum: AAMA 611, Architectural Class I anodized, clear.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install window assemblies in accordance with manufacturer’s instructions and approved Shop Drawings.

B. Set plumb, square, and level.

C. Secure to adjacent construction using fastener type best suited to application.

D. Field alterations to window assemblies not permitted unless approved in advance by manufacturer and Architect.

3.2 ADJUSTING

A. Touch up minor scratches and abrasions in [primer paint] [finish coat] to match factory finish.

END OF SECTION 08 56 69

SECTION 08 71 00 – DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Finish Hardware for door openings other than detention doors, except as otherwise specified herein.

1. Door hardware for steel (hollow metal) doors
2. Door hardware for aluminum doors
3. Door hardware for wood doors
4. Keyed cylinders as indicated.

B. Related Sections

1. Division 6: Rough Carpentry
2. Division 8: Aluminum-Framed Entrances and Storefronts
3. Division 8: Hollow Metal Doors and Frames
4. Division 8: Flush Wood Doors
5. Division 8: Detention Doors and Frames
6. Division 8: Detention Hardware
7. Division 10: Signage
8. Division 26: Electrical
9. Division 28: Electronic Safety and Security

C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.

1. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
2. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2019.
3. BHMA A156.1 - Standard for Butts and Hinges 2021.
4. BHMA A156.2 - Bored and Preassembled Locks and Latches 2017.
5. BHMA A156.3 - Exit Devices 2020.
6. BHMA A156.4 - Door Controls - Closers 2019.
7. BHMA A156.5 - Cylinders and Input Devices for Locks 2020.
8. BHMA A156.6 - Standard for Architectural Door Trim 2021.
9. BHMA A156.7 - Template Hinge Dimensions 2016.
10. BHMA A156.8 - Door Controls - Overhead Stops and Holders 2021.
11. BHMA A156.13 - Mortise Locks & Latches Series 1000 2017.
12. BHMA A156.15 - Release Devices - Closer Holder, Electromagnetic and Electromechanical 2021.
13. BHMA A156.16 - Auxiliary Hardware 2018.
14. BHMA A156.18 - Materials and Finishes 2020.
15. BHMA A156.19 - Power Assist and Low Energy Power Operated Swinging Doors 2019.
16. BHMA A156.21 - Thresholds 2019.
17. BHMA A156.22 - Standard for Gasketing 2021.
18. BHMA A156.23 - Electromagnetic Locks 2017.
19. BHMA A156.25 - Electrified Locking Devices 2018.
20. BHMA A156.26 - Standard for Continuous Hinges 2021.

21. BHMA A156.28 - Recommended Practices For Mechanical Keying Systems 2018.
22. BHMA A156.30 - High Security Cylinders 2020.
23. BHMA A156.31 - Electric Strikes and Frame Mounted Actuators 2019.
24. BHMA A156.36 - Auxiliary Locks 2020.
25. BHMA A156.115 - Hardware Preparation In Steel Doors And Steel Frames 2016.
26. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames 2006.
27. DHI (H&S) - Sequence and Format for the Hardware Schedule 2019.
28. DHI (KSN) - Keying Systems and Nomenclature 2019.
29. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames 2004.
30. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors 1993; also in WDHS-1/WDHS-5 Series, 1996.
31. ICC (IBC) - International Building Code, 2021 Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
32. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
33. ISO 9001 - Quality management systems -- Requirements 2015.
34. ITS (DIR) - Directory of Listed Products Current Edition.
35. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
36. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.
37. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
38. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2022.
39. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2022.
40. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.
41. UL 437 - Standard for Key Locks Current Edition, Including All Revisions.
42. UL 1784 - Standard for Air Leakage Tests of Door Assemblies Current Edition, Including All Revisions.

D. Intent of Hardware Groups

1. Should items of hardware not specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
2. Where items of hardware aren’t specified, are required for completion of the Work, a written statement of such discrepancy to be submitted to Architect, prior to date specified for receipt of bids for clarification by addendum; or furnish such items in the type and quality established by this specification, and appropriate to the service intended

1.2 SUBSTITUTIONS

A. No substitutions are permitted.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Sustainable Design Submittals: Comply with Division 01 Section “Sustainable Design Requirements – LEED”.

1. MR Credit 2: Environmental Product Declarations
   a. Hardware, if available.
2. MR Credit 4: Material Ingredients
   a. Report: Hardware, if available.

C. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.
   h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

D. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

   a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
   b. Complete (risers, point-to-point) access control system block wiring diagrams.
   c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

E. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

F. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

G. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Automatic Operator Supplier Qualifications: Power operator products and accessories are required to be supplied and installed through current members of the manufacturer's "Power Operator Preferred Installer" program. Suppliers are to be factory trained, certified, and a direct purchaser of the specified power operators and be responsible for the installation and maintenance of the units and accessories indicated for the Project.

F. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

G. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

H. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

I. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), Contractor(s), Owner, and Architect to confirm hardware sets and components, review proper methods and procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures.

J. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware.

Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: Two years from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.
2. Five years for exit hardware.
3. Twenty five years for manual overhead door closer bodies.
4. Five years for motorized electric latch retraction exit devices.
5. Two years for electromechanical door hardware, unless noted otherwise.

1.8 MAINTENANCE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following manufacturers are approved subject to compliance with requirements of the Contract Documents. Approval of manufacturers other than those listed shall be in accordance with Division 1.

Item:	Manufacturer:
Hinges	Stanley
Continuous Hinges	Stanley
Locksets	Marks USA
Cylinders	Medeco
Exit Devices	Marks
Closers	Corbin Russwin DC6210-N54
Push/ Pull Plates	Don-Jo
Push/ Pull Bars	Don-Jo
Protection Plates	Don-Jo
Overhead Stops	Don-Jo
Door Stops	Don-Jo
Flush Bolts	Don-Jo
Coordinator & Brackets	Don-Jo
Threshold & Gasket	National Guard

2.2 MATERIALS

1. Hinges:

    1. Template screw hole locations
    2. Minimum of 2 permanently lubricated non-detachable bearings
    3. Equip with easily seated, non-rising pins
    4. Sufficient size to allow 180-degree swing of door
    5. Furnish hinges with five knuckles and flush [concealed] bearings
    6. Provide hinge type as listed in schedule.
    7. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
    8. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish
    9. UL10C listed for Fire rated doors.

2. Geared Continuous Hinges:

    1. Tested and approved by BHMA for ANSI A156.26-1996 Grade 1
    2. Anti-spinning through fastener
    3. ULIOC listed for 3 hour Fire rating
    4. Non-handed
    5. Lifetime warranty
    6. Provide Fire Pins for 3-hour fire ratings
    7. Sufficient size to permit door to swing 180 degrees

3. Electrified Functions for Hinges: Comply with the following:

1. Power transfer: concealed PTFE-jacketed wires, secured at each leaf and continuous through hinge knuckle. Provide wire quantity and sizes required for electric hardware to be served.
2. Monitoring: concealed electrical monitoring switch.
3. Power transfer and monitoring: concealed PTFE-jacketed wires, secured at each leaf and continuous through hinge knuckle, and with concealed electrical monitoring switch.

4. Mortise Type Locks and Latches:

1. Tested and approved by BHMA for ANSI A156.13, Series 1000, Operational Grade 1, Extra— Heavy Duty, Security Grade 2 and be UL10C.
2. Furnish UL or recognized independent laboratory certified mechanical operational testing to 4 million cycles minimum.
3. Provide 9001—Quality Management and 14001—Environmental Management.
4. Fit ANSI A115.1 door preparation
5. Functions and design as indicated in the hardware groups
6. Solid, one—piece, 3/4—inch (l9mm) throw, antifriction latchbolt made of self-lubricating stainless steel
7. Deadbolt functions shall have 1 inch (25mm) throw bolt made of hardened stainless steel
8. Latchbolt and Deadbolt are to extend into the case a minimum of 3/8 inch (9.5mm) when fully extended
9. Auxiliary deadlatch to be made of one piece stainless steel, permanently lubricated
10. Provide sufficient curved strike lip to protect door trim
11. Lever handles must be of forged or cast brass, bronze or stainless-steel construction and conform to ANSI A117.1. Levers that contain a hollow cavity are not acceptable
12. Lock shall have self—aligning, thru—bolted trim
13. Levers to operate a rofler bearing spindle hub mechanism
14. Mortise cylinders of lock shall have a concealed internal setscrew for securing the cylinder to the lockset. The internal setscrew will be accessible only by removing the core, with the control key, from the cylinder body.
15. Spindle to be designed to prevent forced entry from attacking of lever
16. Provide locksets with 7-pin removable and interchangeable core cylinders
17. Each lever to have independent spring mechanism controlling it
18. Core face must be the same finish as the lockset.

5. Cylindrical Type Locks and Latches:

a. Tested and approved by BHMA for ANSI Al56.2, Series 4000, Operational Grade 1, Extra-Heavy Duty, and be ULIOC listed.
b. Provide 9001-Quality Management and 14001-Environmental Management.
c. Fit modified ANSI A1l5.2 door preparation.
d. Locksets and cores to be of the same manufacturer to maintain complete lockset warranty
e. Locksets to have anti-rotational studs that are thru-bolted
f. Keyed lever shall not have exposed “keeper” hole
g. Each lever to have independent spring mechanism controlling it
h. 2-3/4 inch (70 mm) backset
i. 9/16 inch (14 mm) throw latchbolt
j. Provide sufficient curved strike lip to protect door trim
k. Outside lever sleeve to be seamless, of one-piece construction made of a hardened steel alloy
l. Keyed lever to be removable only after core is removed, by authorized control key
m. Provide locksets with 7-pin removable and interchangeable core cylinders

n. Hub, side plate, shrouded rose, locking pin to be a one-piece casting with a shrouded locking lug.
o. Locksets outside locked lever must withstand minimum 1400 inch pounds of torque. In excess of that, a replaceable part will shear. Key from outside and inside lever will still operate lockset.
p. Core face must be the same finish as the lockset.
q. Functions and design as indicated in the hardware groups.

6. Cylindrical Grade 2 Type Locks and Latches:

a. Certified by BHMA for ANSI A156.3, Series 4000, Operational Grade 2.
b. Fit modified ANSI A115.3 door preparation
c. Locksets and cores to be of the same manufacturer to maintain complete lockset warranty
d. 2-3/4 inch (70mm) backset, or 2 3/8 inch backset as needed
e. 1/2 inch (14mm) throw latchbolt
f. Provide locksets with 7-pin *code.*
g. Functions and design as indicated in the hardware groups

7. Exit Devices:

a. Exit devices to meet or exceed BHMA for ANSI 156.3, Grade 1.
b. Exit devices to be tested and certified by UL or by a recognized independent laboratory for mechanical operational testing to 9 million cycles minimum with inspection confirming Grade 1 Loaded Forces have been maintained.
c. Exit devices chassis to be investment cast steel, zinc dichromate.
d. Exit devices to have stainless steel deadlocking 3/4” through latch bolt.
e. Exit devices to be equipped with sound dampening on touchbar.
f. Non-fire rated exit devices to have cylinder dogging.
g. Non-fire rated exit devices to have 1/4” minimum turn hex key dogging.
h. Touchpad to be “T” style constructed of architectural metal with matching metal end caps.
i. Touchbar assembly on wide style exit devices to have a 1/4” clearance to allow for vision frames.
j. All exposed exit device components to be of architectural metals and “true” architectural finishes.
k. Provide strikes as required by application.
l. Fire exit hardware to conform to UL10C and UBC 7-2. UL tested for Accident Hazard.
m. Exit device to be heavy investment cast stainless steel with black powder coated finish.
n. Exit devices to have field reversible handing.
o. Provide heavy duty vandal resistant lever trim with heavy duty investment cast stainless steel components and extra strength shock absorbing overload springs. Lever shall not require resetting. Lever design to match locksets and latchsets.
p. Provide 9001-Quality Management and 14001 -Environmental Management.
q. Vertical Latch Assemblies to have gravity operation, no springs.

8. Cylinders:

a. Provide the necessary cylinder housings, collars, rings & springs as recommended by the manufacturer for proper installation.
b. Provide the proper cylinder cams or tail piece as required to operate all locksets and other keyed hardware items listed in the hardware sets.
c. Coordinate and provide as required for related sections.

9. Door Closers:

   a. Tested and approved by BHMA for ANSI 156.4, Grade 1
   b. UL10C certified
   c. Provide 9001—Quality Management and 14001-Environmental Management.
   d. Closer shall have extra—duty arms and knuckles
   e. Conform to ANSI 117.1
   f. Maximum 2 7/16 inch case projection with non-ferrous cover
   g. Separate adjusting valves for closing and latching speed, and backcheck
   h. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions
   i. Full rack and pinion type closer with 1 1/2“ minimum bore
   j. Mount closers on non-public side of door, unless otherwise noted in specification
   k. Closers shall be non-handed, non-sized and multi-sized.

10. Door Stops:

   a. Wall stop and floor stop shall be wrought bronze, brass or stainless steel.
   b. Provide fastener suitable for wall construction.
   c. Coordinate reinforcement of walls where wall stop is specified.
   d. Provide dome stops where wall stops are not practical. Provide spacers or carpet riser for floor conditions encountered

11. Overhead Stops: Provide a Surface mounted or concealed overhead when a floor or wall stop cannot be used or when listed in the hardware set.

   a. Concealed overhead stops shall be heavy duty bronze or stainless steel.
   b. Surface overhead stops shall be heavy duty bronze or stainless steel.

12. Push Plates: Provide with four beveled edges ANSI J301, .050 thickness, size as indicated in hardware set. Furnish oval-head countersunk screws to match finish.

13. Pulls with Plates: Provide with four beveled edges ANSI J30l, .050 thickness plates with ANSI J401 Pull as listed in hardware set. Provide proper fasteners for door construction.

14. Push/ Pull Bars: Provide ANSI J504, 1” Dia. Pull and push bar model and series as listed in hardware set. Provide proper fasteners for door construction.

15. Kickplates: Provide with four beveled edges ANSI J102, 10 inches high by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

16. Mop Plates: Provide with four beveled edges ANSI Jl03, 4 inches high by width less 1 inch on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

17. Door Bolts: Flush bolts for wood or metal doors.

   a. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 25 for hollow metal label doors.
   b. Provide a set of Automatic bolts, Certified ANSUBHMA 156.3 Type 27 at wood label doors.

c. Manual flush bolts, Certified ANSI/BHMA 156.16 at openings where allowed local authority.
d. Provide Dust Proof Strike, Certified ANSI/BHMA 1J6.16 at doors with flush bolts without thresholds.

18. Coordinator and Brackets: Provide a surface mounted coordinator when automatic bolts are used in the hardware set.

a. Coordinator, Certified ANSI/BHMA A1156.3 Type 2lA for full width of the opening.
b. Provide mounting brackets for soffit applied hardware.
c. Provide hardware preparation (cutouts) for latches as necessary.

19. Power Supply:

a. Provide power supply for (ELR) Electric Latch Retraction exit devices
   i. Motherboard will accept up to four plug—in Control Modules. Provide the appropriate necessary control module to operate the number of ELR exit devices used at each opening. The Control Module shall include a Time delay Feature, variable (0-4 minutes) latch retraction period in response to a momentary input.
   ii. UL Listed for class II output
   iii. Include circuit breakers for protection of motherboard
   iv. 115 or 230 Volt user selectable switch, with AC input = 115 Volt at 1 Amp
   v. Control module shall include Fire alarm terminal and Auxiliary contacts for remote signaling.
   vi. Optional card for Battery Backup (BT) power tap module to operate a Card reader or when ELR devices require battery backup (Lead Acid Batteries are not included and is to be furnished by others)

b. Provide power supply that is UL Listed, Field Selectable 12VDC or 24VDC output. The power supply will be specifically designed to support electric locks and access controls. The power supply uses 115 VAC at 800mA input. The power shall be able to be expanded to four station controls. The filtered and regulated output power is field selectable for 12 or 24 VDC.
   i. Fire Alarm/Life Safety emergency release included in power supply.
   ii. Available options for multiple door options four or more control stations, Adjustable Time delay relay, Battery charging, Battery Backup.

20. Power Transfer: Power transfer device shall be a steel housing and flexible tube. Secure and inconspicuous channel is to bring power from the frame to the door.

a. Precision EPT-5
b. Tube shall accept up to 5/16” wire bundle and accommodate a door swing of 120 Deg.
c. Wires as required by others

21. Surface Mounted Door Loop Power Transfer: Armored flex conduit is to bring power from the frame to the door. The tube shall accept up to 1/4” wire bundle and is 18” long.

a. Precision EPT-2
b. Wires as required by others.

22. Electric Door Strike: Certified by ANSI/BHMA 1J6.31, Grade 1. and listed for Burglary Protection ANSI/ ULI034 Grade 1.

a. For General use provide fail-secure electric strike and with fire-rated device.
b. Listed UL10C for Fire Door assemblies

c. Latchbolt monitor switch option when specified in hardware sets.
d. Provide the electric strike in the appropriate model that will accept a 5/8” or 3/4" latchbolt.

23. Door Position Switch: Provided by Security Contractor for door status monitoring as indicated in hardware sets.

a. At all fired rated doors the door and frames, position switch preparation will be provided by the door and frame manufacturer or by an authorized label service agent.

24. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.

25. Weatherstripping: Provide at head and jambs only those units where resilient or flexible-seal strip is easily replaceable. Where bar-type weatherstrip is used with parallel arm mounted closers install weatherstrip first.

a. Weatherstrip shall be resilient seal of Silicone
b. ULIOC Positive Pressure rated seal set when required.

26. Door Bottom/ Sweeps: Surface mounted or concealed door bottom where listed in the hardware sets.

a. Door seal shall be resilient seal of Silicone
b. UL10C Positive Pressure rated seal set when required.

27. Thresholds: Thresholds shall be aluminum beveled type with maximum height of 1/2” for conformance with ADA requirements. Furnish as specified and per details. Provide fasteners and screws suitable for floor conditions.

28. Key Cabinet: Provide one wall mounted Telkee, Lund or MMF series key cabinet complete with hooks, index and tags to accommodate 50% expansion. Coordinate mounting location with architect.

29. Silencers: Furnish silencers on all interior frames, 3 for single doors, 2 for pairs. Omit where any type of seals occur.

2.3 FINISH

A. Designations used in Schedule of Finish Hardware - 3.05, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products

B. Powder coat door closers to match other hardware, unless otherwise noted.

C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.4 KEYS AND KEYING

A. Provide keyed brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished in the same keyway (or key section) as the Owner's

permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner.

B. Cylinders, removable and interchangeable core system: MEDECO.

C. Permanent keys and cores: stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys will also be stamped “Do Not Duplicate.”

D. Transmit Grand Masterkeys, Masterkeys, and other Security keys to Owner by Registered Mail, return receipt requested.

E. Furnish Keys in the following quantities:

1. 1 each Grand Masterkeys
2. 4 each Masterkeys
3. 2 each Change keys each keyed core
4. 15 each Construction masterkeys
5. 1 each Control keys

F. The Owner, or the Owner's agent, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.

G. Keying Schedule: Arrange for a keying meeting, and programming meeting with Architect Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying and programming complies with project requirements. Furnish 3 typed copies of keying and programming schedule to Architect.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.

a. Do not proceed until unsatisfactory conditions have been corrected.

3.2 HARDWARE LOCATIONS

A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.

1. Recommended Locations for Builder’s Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).
2. Recommended locations for Architectural Hardware for flush wood doors (DHI).
3. WDMA Industry Standard I.S.-IA-04, Industry Standard for Architectural wood flush doors.

3.3 INSTALLATION

A. Install each hardware item per manufacturer's instructions and recommendations. Do not

install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

B. Conform to local governing agency security ordinance.

C. Install Conforming to ICC/ANSI A117.1 Accessible and Usable Building and Facilities.

1. Adjust door closer sweep periods so that from the open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door.

D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use “Riv-Nuts” or similar products.

3.4 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

A. Contractor/installers, Field Services: After installation is complete, contractor shall inspect the completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final shop drawings.

1. Check and adjust closers to ensure proper operation.
2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.

i. Verify levers are free from binding.
ii. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.

3. Report findings, in writing, to architect indicating that all hardware is installed and functioning properly. Include recommendations outlining corrective actions for improperly functioning hardware if required.

3.5 SCHEDULE OF FINISH HARDWARE

Manufacturer List:

Code	Name
BY	By Related Section
CR	Corbin Russwin
DJ	Don-Jo
MA	Marks
MD	Medeco
NA	National Guard
ST	Stanley
BO	By Owner/ Others

Finish List:

Code	Description
15	Satin Nickel Plate
28	Aluminum Anodized (Clear)
32D	Satin Stainless Steel

626	Satin Chromium Plated
628	Satin Aluminum, Clear Anodized
630	Satin Stainless Steel
689	Aluminum Painted
AL	Aluminum
CL	Clear
US32D	Stainless Steel, Dull

Hardware Sets

Set 1 - Public Access – Ext. AL SF – Access Control, CR on Ext, Monitored w/Remote Buzzer, ADA operators.

Doors: 001, 002A

2	Continuous Hinge	By HDW Contractor	AL	ST
1	Removable Mullion	By HDW Contractor	689	BY
2	Exit Device	By HDW Contractor	630	MA
3	Rim Cylinder	By HDW Contractor	626	BY
2	Mortise Cylinder	By HDW Contractor	626	BY
2	Core	By HDW Contractor	626	MD
2	Door Pull	By HDW Contractor	630	DJ
2	Closer	By HDW Contractor	689	CR
2	Overhead Stop	By HDW Contractor	689	DJ
1	Card Reader	Furnished and Installed by the Security Contractor		BO
3	Harness	By HDW Contractor		ST
1	Wiring Diagram	By HDW Contractor		BY
2	Power Transfer	By HDW Contractor		BY
2	Door Position Switch	By HDW Contractor	WHITE	BY
2	Backup Battery	By HDW Contractor		BE
1	Surface Mounting Box	By HDW Contractor		BY
1	Actuator	By HDW Contractor	630	BY
2	Harness	By HDW Contractor		ST
1	Low Energy Operator	By HDW Contractor	628	BY
1	Power Supply	By HDW Contractor		BY
1	Meeting Stile Seal	Provided by the Alum. Door Mfg.		BY
2	Drip Cap	By HDW Contractor		NA
1	Mullion Seal	By HDW Contractor		NA
2	Weather-Stripping	Provided by ALD/F MFR		BO
	Gasket	GASKETING BY ALUMINUM DOOR MANUFACTURER		BY
2	Door Sweep	By HDW Contractor		NA
1	Threshold	By HDW Contractor	AL	NA
2	ADA Operator	By HDW Contractor	AL	BY

OPERATION DESCRIPTION: Door normally open 24/7. When in lockdown, presenting valid credentials to Card Reader or mechanical key will momentarily release lock. Free egress from

interior at all times. With loss of power or activation of Fire Alarm System secure side will remain locked.

Set 1.1 - Sally Port Staff Door – Ext. HMD /HMF w/Ext CR remote buzzer
Doors: 150C, 150D

1	Continuous Hinge	By HDW Contractor	BK	ST
1	Exit Device	By HDW Contractor	630	MA
1	Rim Cylinder	By HDW Contractor	626	MA
1	Mortise Cylinder	195RDW/26D	626	MA
1	Core	By HDW Contractor	626	MD
1	Overhead Stop	By HDW Contractor	689	DJ
1	Kick Plate	By HDW Contractor	630	DJ
1	Card Reader	Furnished and Installed by the Security Contractor		BO
2	Harness	By HDW Contractor		ST
1	Wiring Diagram	Furnished by Hardware Supplier		BY
1	Power Transfer	By HDW Contractor		BY
1	Door Position Switch	By HDW Contractor	WHITE	BY
2	Backup Battery	By HDW Contractor		BY
2	Surface Mounting Box	By HDW Contractor		BY
2	Actuator	By HDW Contractor	630	BY
1	Harness	By HDW Contractor		ST
1	Low Energy Operator	By HDW Contractor	628	BY
1	Power Supply	By HDW Contractor		BY
1	Drip Cap	By HDW Contractor		NA
1	Smoke Seal	By HDW Contractor		NA
1	Door Sweep	By HDW Contractor		NA
1	Threshold	By HDW Contractor	AL	NA

OPERATION DESCRIPTION: Door normally closed, latched and secure. Presenting valid credentials to Card Reader or mechanical key will momentarily release lock. Free egress from interior at all times. With loss of power or activation of Fire Alarm System secure side will remain locked.

Set 1.2 - Staff Access – Ext. HMD /HMF - Access Control, w/Ext CR & Sound Gasket
Doors: 003, 004

1	Continuous Hinge	By HDW Contractor	BK	ST
1	Exit Device	By HDW Contractor	630	MA
1	Rim Cylinder	By HDW Contractor	626	MA
1	Mortise Cylinder	195RAB/26D	626	MA
1	Core	By HDW Contractor	626	MD
1	Overhead Stop	By HDW Contractor	689	DJ
1	Kick Plate	By HDW Contractor	630	DJ
1	Card Reader	Furnished and Installed by the Security Contractor		BO
2	Harness	By HDW Contractor		ST
1	Wiring Diagram	Furnished by Hardware Supplier		BY
1	Power Transfer	By HDW Contractor		BY
1	Door Position Switch	By HDW Contractor	WHITE	BY
2	Backup Battery	By HDW Contractor		BY
2	Surface Mounting Box	By HDW Contractor		BY
2	Actuator	By HDW Contractor	630	BY
1	Harness	By HDW Contractor		ST

1	Low Energy Operator	By HDW Contractor	628	BY
1	Power Supply	By HDW Contractor		BY
1	Drip Cap	By HDW Contractor		NA
1	Smoke Seal	By HDW Contractor		NA
1	Door Sweep	By HDW Contractor		NA
1	Threshold	By HDW Contractor	AL	NA
1	Sound gasket	By HDW Contractor		

OPERATION DESCRIPTION: Door normally closed, latched and secure. Presenting valid credentials to Card Reader or mechanical key will momentarily release lock. Free egress from interior at all times. With loss of power or activation of Fire Alarm System secure side will remain locked.

Set 1.3 - Sally Port OHD – Ext. OHD with remote opening
Door: 150A, 150B
Coordinate with Overhead Door provider & County OIT

Set 1.4 – Exit with Ext. CR– HMD/HMF
Door: S01B

1	Continuous Hinge	By HDW Contractor	BK	ST
1	Exit Device	By HDW Contractor	630	MA
1	Rim Cylinder	By HDW Contractor	626	MA
1	Mortise Cylinder	By HDW Contractor	626	MA
1	Core	By HDW Contractor	626	MD
1	Overhead Stop	By HDW Contractor	689	DJ
1	Kick Plate	By HDW Contractor	630	DJ
1	Card Reader	Furnished and Installed by the Security Contractor		BO
2	Harness	By HDW Contractor		ST
1	Wiring Diagram	Furnished by Hardware Supplier		BY
1	Power Transfer	By HDW Contractor		BY
1	Door Position Switch	By HDW Contractor	WHITE	BY
2	Backup Battery	By HDW Contractor		BY
2	Surface Mounting Box	By HDW Contractor		BY
2	Actuator	By HDW Contractor	630	BY
1	Harness	By HDW Contractor		ST
1	Low Energy Operator	By HDW Contractor	628	BY
1	Power Supply	By HDW Contractor		BY
1	Drip Cap	By HDW Contractor		NA
1	Smoke Seal	By HDW Contractor		NA
1	Door Sweep	By HDW Contractor		NA
1	Threshold	By HDW Contractor	AL	NA

OPERATION DESCRIPTION: Door normally closed, latched and secure. Presenting valid credentials to Card Reader or mechanical key will momentarily release lock. Free egress from interior at all times. With loss of power or activation of Fire Alarm System secure side will remain locked.

Set 1.5 – Exit Only - Ext. AL SF– No exterior trim. Ballistic
Door: 100C

1	Continuous Hinge	By HDW Contractor	AL	ST
1	Exit Device	By HDW Contractor	630	MA

1	Rim Cylinder	By HDW Contractor	626	BY
1	Core	By HDW Contractor	626	MD
1	Closer	By HDW Contractor	689	CR
1	Overhead Stop	By HDW Contractor	689	DJ
1	Kick Plate	By HDW Contractor	630	DJ
1	Door Position Switch	By HDW Contractor	WHITE	BY
1	Drip Cap	By HDW Contractor		NA
1	Weather-Stripping	Provided by ALD/F MFR		BO
1	Door Sweep	By HDW Contractor		NA
1	Threshold	By HDW Contractor	AL	NA

Set 1.6 – NOT USED

Set 1.7 – Exterior Site Fence Gate Personnel Door
Door: See Landscape Plans. Provide components for exterior access control

Set 1.8 – Exterior Swing Gate Access Control
Door: See Landscape Plans. Provide components for exterior access control.

Set 2 - Restrooms & Wellness Rms - HMD/HMF SI w/Indicator 45 M
Doors: 111, 112, 125, 126, 130

3	Hinges	By HDW contractor	US32D	ST
1	Privacy Set (F76)	195L/26D	626	MA
1	Door Closer	By HDW contractor	689	CR
I	Kick Plate	By HDW contractor	630	DJ
I	Mop Plate	By HDW contractor	630	DJ
I	Wall Stop	By HDW contractor	US32D	DJ
1	Hat & Coat Hook	By HDW contractor	US32D	DJ
3	Door Silencers	By HDW contractor	GRAY	DJ

Set 2.1 - Restrooms & Wellness Rms - WDD/HMF SI w/Indicator 45 M
Doors: 216C, 222, 227

3	Hinges	By HDW contractor	US32D	ST
1	Privacy Set (F76)	195L/26D	626	MA
1	Door Closer	By HDW contractor	689	CR
I	Kick Plate	By HDW contractor	630	DJ
I	Mop Plate	By HDW contractor	630	DJ
I	Wall Stop	By HDW contractor	US32D	BY
1	Hat & Coat Hook	By HDW contractor	US32D	BY

Set 3 - IT Room – HMD/HMF w/ Access Control, Ext. side Card Reader
Doors: 119, 223

1	Continuous Hinge	By HDW contractor	AL	ST
1	Rim Cylinder	195RF/26D	626	MA
1	Core	By HDW contractor	626	MD

1	Electric Strike	By HDW contractor	630	BY
1	Closer	By HDW contractor	693	CR
1	Overhead Stop	By HDW contractor	689	DJ
1	Kick Plate	By HDW contractor	630	DJ
1	Card Reader	Furnished and Installed by the Security Contractor		BO
2	Harness	By HDW contractor		ST
1	Wiring Diagram	Furnished by Hardware Supplier		BY
1	Door Position Switch	By HDW contractor	WHITE	BY
2	Backup Battery	By HDW contractor		BY
1	Power Supply	By HDW contractor		BY
1	Smoke Seal	By HDW contractor		NA
1	Door Sweep	By HDW contractor		NA
1	Threshold	By HDW contractor	AL	NA

Set 4 – Evidence Processing – HMD/HMF w/Card Reader, Sound gasketing
Doors: 121A, 121B

1	Continuous Hinge	By HDW contractor	AL	ST
1	Exit Device	By HDW contractor	630	MA
1	Rim Cylinder	195N/26D	626	MA
1	Core	By HDW contractor	626	MD
1	Electric Strike	By HDW contractor	630	BY
1	Closer	By HDW contractor	693	CR
1	Overhead Stop	By HDW contractor	689	DJ
1	Kick Plate	By HDW contractor	630	DJ
1	Card Reader	Furnished and Installed by the Security Contractor		BO
2	Harness	By HDW contractor		ST
1	Wiring Diagram	Furnished by Hardware Supplier		BY
1	Door Position Switch	By HDW contractor	WHITE	BY
2	Backup Battery	By HDW contractor		BY
1	Power Supply	By HDW contractor		BY
1	Drip Cap	By HDW contractor		NA
1	Smoke Seal	By HDW contractor		NA
1	Door Sweep	By HDW contractor		NA
1	Threshold	By HDW contractor	AL	NA
1	Sound Gasketing	By HDW contractor		BY

Set 5 – Office Suite
Doors: 104, 106, 108, 202, 207A, 211, 215, 217A, 219A

3	Hinge	By HDW Contractor	32D	ST
1	Entry Lock	195RAB/26D	630	MA
1	Cylinder Core	By HDW Contractor	626	MD
1	Closer	By HDW Contractor	689	CR
1	Wall Bumper	By HDW Contractor	626	DJ
1	Sound Gasketing	By HDW Contractor @ Head & Jambs		BY
1	Threshold	By HDW contractor	AL	NA

Set 6 – Private Office
Doors: 103, 105, 109, 149, 203, 204, 206, 208, 213, 216A, 218, 220,

3	Hinge	By HDW Contractor	32D	ST
1	Entry Lock	195RAB/26D	630	MA
1	Cylinder Core	By HDW Contractor	626	MD
1	Closer	By HDW Contractor	689	CR
1	Wall Bumper	By HDW Contractor	626	DJ
1	Coat Hook	By HDW Contractor	630	DJ
1	Sound Gasketing	By HDW Contractor @ Head & Jambs		BY
1	Threshold	By HDW contractor	AL	NA

Set 7 - Passage doors & Closets – non locking
Doors: 101A, 101B, 107, 116, 120, 127, 149A, 207B, 209A, 209B, 216B, 217B, 217C, 219B, 224, 228, 229, 230, S01A*, S01C*, S02A*, S02C*
*provide rated hardware

3	Hinge	By HDW Contractor	32D	ST
1	Passage Set	195N/26D	630	MA
1	Wall stop	By HDW Contractor		DJ
1	Sound Gasketing	By HDW Contractor @ Head & Jambs		BY
1	Threshold	By HDW contractor	AL	NA

Set 8 – Storage Closets – Locking – HMD/HMF
Doors: 110*, 117A, 117B, 137D, 150E,
*provide rated hardware

3	Hinge	By HDW Contractor	32D	ST
1	Storeroom Lock	195RF/26D	630	MA
1	Core	By HDW contractor	626	MD
1	Closer	By HDW contractor	693	CR
1	Kick Plate	By HDW contractor	630	BY
1	Wall stop	By HDW Contractor		DJ
1	Door Sweep	By HDW contractor		NA
1	Sound Gasketing	By HDW Contractor @ Head & Jambs		BY
1	Threshold	By HDW contractor	AL	NA

Set 8.1 – Storage Closets – Locking – WDD/HMF
Doors: 100D (pair), 102, 201, 221, 225, 226

3	Hinge	By HDW Contractor	32D	ST
1	Storeroom Lock	195RF/26D	630	MA
1	Core	By HDW contractor	626	MD
1	Closer	By HDW contractor	693	CR
1	Kick Plate	By HDW contractor	630	BY
1	Wall stop	By HDW Contractor		DJ
1	Door Sweep	By HDW contractor		NA
1	Sound Gasketing	By HDW Contractor @ Head & Jambs		BY
1	Threshold	By HDW contractor	AL	NA

Set 9* – Detention Mechanical Closet – Locking w/Louvers DHMD/ DHMF
Doors: 006A, 006B, 137B, 137C
*See Detention Doors & Hardware

Set 9.1* – Detention Mechanical Closet – Locking DHMD/DHMF – see 08 71 20
Doors: 006C, 131
*See Detention Doors & Hardware

Set 9.2 – Mech / Electrical Closet – HMD/HMF – exit device
Doors: 113A*, 114*
*provide rated hardware

1	Continuous Hinge	By HDW Contractor	AL	ST
1	Removable Mullion	By HDW Contractor	689	BY
1	Exit Device	By HDW Contractor	630	MA
1	Rim Cylinder	195RF/26D	626	MA
1	Core	By HDW Contractor	626	MD
1	Closer	By HDW Contractor	689	CR
1	Overhead Stop	By HDW Contractor	689	DJ
1	Smoke Seal	By HDW Contractor @ Head & Jambs		NA
1	Mullion Seal	By HDW Contractor		NA
1	Door Sweep	By HDW Contractor		NA
1	Threshold	By HDW Contractor	AL	NA

Set 9.3 – Mech / Electrical Closet – HMD/HMF – exit device
Doors: 113B

1	Continuous Hinge	By HDW Contractor	AL	ST
1	Removable Mullion	By HDW Contractor	689	BY
1	Exit Device	By HDW Contractor	630	MA
1	Rim Cylinder	195RF/26D	626	MA
1	Core	By HDW Contractor	626	MD
1	Closer	By HDW Contractor	689	CR
1	Overhead Stop	By HDW Contractor	689	DJ
1	Smoke Seal	By HDW Contractor @ Head & Jambs		NA
1	Mullion Seal	By HDW Contractor		NA
1	Door Sweep	By HDW Contractor		NA
1	Threshold	By HDW Contractor		NA

Set 9.4 – Mechanical Closet – Locking WDD/ HMF
Doors: 101C, 101D

1	Continuous Hinge	By HDW Contractor	AL	ST
1	Rim Cylinder	195RF/26D	626	MA
1	Core	By HDW Contractor	626	MD
1	Closer	By HDW Contractor	689	CR
1	Overhead Stop	By HDW Contractor	689	DJ
1	Smoke Seal	By HDW Contractor @ Head & Jambs		NA
1	Door Sweep	By HDW Contractor		NA

1	Threshold	By HDW Contractor		NA

Set 9.5 – Roof Access – IHMD/IHMF - Exterior door w/ Access Control
Doors: 008

1	Continuous Hinge	By HDW Contractor	AL	ST
1	Electromechanical IDH	By HDW Contractor	630	BO
1	Core	195RF/26D	626	MD
1	Closer	By HDW Contractor	689	CR
1	Overhead Stop	By HDW Contractor	689	DJ
1	Kick Plate	By HDW Contractor	630	DJ
2	Harness	By HDW Contractor		ST
1	Wiring Diagram	Furnished by Hardware Supplier		BY
1	Power Transfer	By HDW Contractor		BY
1	Door Position Switch	By HDW Contractor	WHITE	BY
2	Backup Battery	By HDW Contractor		BY
1	Harness	By HDW Contractor		ST
1	Power Supply	By HDW Contractor		BY
1	Drip Cap	By HDW Contractor		NA
1	Smoke Seal	By HDW Contractor @ Head & Jambs		NA
1	Door Sweep	By HDW Contractor		NA
1	Threshold	By HDW Contractor	AL	NA

Set 10* – Detention Sliding – DHMD/DHMF Sliding Remote release
Doors: 129, 132, 133, 141
*See Detention Doors & Hardware

Set 10.1* – Detention Swinging – DHMD/DHMF w/ Access Control
Doors: 134, 141, 142, 143, 144, 145, 146, 148
*See Detention Doors & Hardware

Set 10.2* – Detention Swinging – DHMD/DHMF w/ Access Control, intercom & remote release
Doors: 135A, 140A
*See Detention Doors & Hardware

Set 10.3* – Detentions Swinging Passage
Doors: 135B, 135C, 136, 140B, 140C
*See Detention Doors & Hardware

Set 10.4* – Detention Swinging Access Control on both sides
Doors: 137A,
*See Detention Doors & Hardware

Set 10.5* – Detention Swinging DHMD/DHMF Storage
Doors: 138, 139
*See Detention Doors & Hardware

Set 11 – Corridor - Access Control – CR on Ext. & Int. Sides
Doors: 005, 006, 123B, 124B

2	Hinges	By HDW Contractor	US26D	ST
1	Elect. Hinges	By HDW Contractor	US26D	ST

1	Elect Strike Mortise Lock	195RDW/26D	626	MA
2	Card Reader	Furnished and Installed by the Security Contractor		BO
1	Core	By HDW Contractor	626	MD
1	Closer	By HDW Contractor	689	CR
3	Door Silencers	By HDW Contractor		DJ
1	Wall Bumper	By HDW Contractor	626	DJ
1	Harness	By HDW Contractor		ST
1	Wiring Diagram	Furnished by Hardware Supplier		BY
1	Power Transfer	By HDW Contractor		BY
1	Door Position Switch	By HDW Contractor	WHITE	BY
2	Backup Battery	By HDW Contractor		BY
1	Harness	By HDW Contractor		ST
1	Power Supply	By HDW Contractor		BY

Set 11.1 – Corridor - Access Control – CR on one side
Doors: 100B

2	Hinges	By HDW Contractor	US26D	ST
1	Elect. Hinges	By HDW Contractor	US26D	ST
1	Elect Strike Mortise Lock	195RF/26D	626	MA
1	Card Reader	Furnished and Installed by the Security Contractor		BO
1	Core	By HDW Contractor	626	MD
1	Closer	By HDW Contractor	689	CR
3	Door Silencers	By HDW Contractor		DJ
1	Wall Bumper	By HDW Contractor	626	DJ
1	Harness	By HDW Contractor		ST
1	Wiring Diagram	Furnished by Hardware Supplier		BY
1	Power Transfer	By HDW Contractor		BY
1	Door Position Switch	By HDW Contractor	WHITE	BY
2	Backup Battery	By HDW Contractor		BY
1	Harness	By HDW Contractor		ST
1	Power Supply	By HDW Contractor		BY

Set 11.2 – Corridor - Access Control – CR on one side, and Deadbolt
Doors: 115

2	Hinges	By HDW Contractor	US26D	ST
1	Elect. Hinges	By HDW Contractor	US26D	ST
1	Elect Strike Mortise Lock	195RF/26D	626	MA
2	Card Reader	Furnished and Installed by the Security Contractor		BO
1	Dead Bolt	By HDW Contractor	626	MA
1	Core	By HDW Contractor	626	MD
1	Closer	By HDW Contractor	689	CR
3	Door Silencers	By HDW Contractor		DJ
1	Wall Bumper	By HDW Contractor	626	DJ
1	Harness	By HDW Contractor		ST
1	Wiring Diagram	Furnished by Hardware Supplier		BY
1	Power Transfer	By HDW Contractor		BY
1	Door Position Switch	By HDW Contractor	WHITE	BY
2	Backup Battery	By HDW Contractor		BY
1	Harness	By HDW Contractor		ST
1	Power Supply	By HDW Contractor		BY

Set 11.3 – Exterior - Access Control – CR on one side
Doors: S02B

2	Hinges	By HDW Contractor	US26D	ST
1	Elect. Hinges	By HDW Contractor	US26D	ST
1	Elect Strike Mortise Lock	195RF/26D	626	MA
2	Card Reader	Furnished and Installed by the Security Contractor		BO
1	Core	By HDW Contractor	626	MD
1	Closer	By HDW Contractor	689	CR
3	Door Silencers	By HDW Contractor		DJ
1	Wall Bumper	By HDW Contractor	626	DJ
1	Harness	By HDW Contractor		ST
1	Wiring Diagram	Furnished by Hardware Supplier		BY
1	Power Transfer	By HDW Contractor		BY
1	Door Position Switch	By HDW Contractor	WHITE	BY
2	Backup Battery	By HDW Contractor		BY
1	Harness	By HDW Contractor		ST
1	Power Supply	By HDW Contractor		BY
1	Gasketing	By HDW Contractor		BY
1	Wall stop	By HDW Contractor		DJ
1	Kick plate	By HDW Contractor		DJ
1	Drip Cap	By HDW Contractor		NA
1	Weatherstrip	By HDW Contractor		BY
1	Door Sweep	By HDW Contractor		BY

Set 11.4 – Interior - Access Control – CR on one side - Ballistic
Doors: 002B, 123A, 124A

2	Hinges	By HDW Contractor	US26D	ST
1	Elect. Hinges	By HDW Contractor	US26D	ST
1	Elect Strike Mortise Lock	195RAB/26D	626	MA
1	Card Reader	Furnished and Installed by the Security Contractor		BO
1	Core	By HDW Contractor	626	MD
1	Closer	By HDW Contractor	689	CR
3	Door Silencers	By HDW Contractor		DJ
1	Wall Bumper	By HDW Contractor	626	DJ
1	Harness	By HDW Contractor		ST
1	Wiring Diagram	Furnished by Hardware Supplier		BY
1	Power Transfer	By HDW Contractor		BY
1	Door Position Switch	By HDW Contractor	WHITE	BY
2	Backup Battery	By HDW Contractor		BY
1	Harness	By HDW Contractor		ST
1	Power Supply	By HDW Contractor		BY
1	Gasketing	By HDW Contractor		BY
1	Kick plate	By HDW Contractor		DJ

Set 11.5 – Interior - Access Control – CR on one side - Ballistic
Doors: 100A

4	Hinges	By HDW Contractor	US26D	ST

2	Elect. Hinges	By HDW Contractor	US26D	ST
2	Elect Strike Mortise Lock	195RAB/26D	626	MA
1	Card Reader	Furnished and Installed by the Security Contractor		BO
2	Core	By HDW Contractor	626	MD
2	Closer	By HDW Contractor	689	CR
6	Door Silencers	By HDW Contractor		DJ
2	Harness	By HDW Contractor		ST
1	Wiring Diagram	Furnished by Hardware Supplier		BY
2	Power Transfer	By HDW Contractor		BY
2	Door Position Switch	By HDW Contractor	WHITE	BY
2	Backup Battery	By HDW Contractor		BY
2	Harness	By HDW Contractor		ST
2	Power Supply	By HDW Contractor		BY
2	Gasketing	By HDW Contractor		BY
2	Wall stop	By HDW Contractor		BY
2	Kick plate	By HDW Contractor		DJ

Set 11.6 – Corridor - Access Control – CR on one side
Doors: 118

4	Hinges	By HDW Contractor	US26D	ST
2	Elect. Hinges	By HDW Contractor	US26D	ST
2	Elect Strike Mortise Lock	195RDW/26D	626	MA
1	Card Reader	Furnished and Installed by the Security Contractor		BO
2	Core	By HDW Contractor	626	MD
2	Closer	By HDW Contractor	689	CR
6	Door Silencers	By HDW Contractor		DJ
2	Wall Bumper	By HDW Contractor	626	DJ
2	Harness	By HDW Contractor		ST
1	Wiring Diagram	Furnished by Hardware Supplier		BY
2	Power Transfer	By HDW Contractor		BY
2	Door Position Switch	By HDW Contractor	WHITE	BY
2	Backup Battery	By HDW Contractor		BY
2	Harness	By HDW Contractor		ST
2	Power Supply	By HDW Contractor		BY

END OF SECTION 08 71 00

SECTION 08 71 20 - DETENTION HARDWARE

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Detention door hardware and related accessories.
   2. Electronic security system hardware devices and coordination.
   3. Installation and Systems Testing after the control center is connected and operational.

B. Related Sections:
   1. Division 08: Door Hardware, including Part 1 requirements, which apply.
   2. Division 08: Detention Doors and Frames.
   3. Division 26: Electrical.

1.2 SUBMITTALS

A. Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedure Section.

B. Product Data: Include Manufacturer's specifications and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
   1. Indicate by transmittal that installation instructions have been distributed to the installer.
   2. Include photographs, catalog cuts, marked templates, and other data as may be required to show compliance with these specifications.

C. Shop Drawings: Prepared by or under ae supervision of the supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Provide details of electrified door hardware, indicating the following.
   1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Include the following:
      a. System schematic.
      b. Point-to-point wiring diagram.
      c. Riser diagram.
      d. Elevation of each door.
   2. Detail interface between electrified door hardware and security system

D. Samples: For exposed door hardware of each scheduled type, in specified finish, full size. Tag with full description for coordination with the Door Hardware Schedule. Submit samples before, or concurrent with, submission of the final Door Hardware Schedule.
   1. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

E. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
   1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and

Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.
   a. Organize door hardware sets in same order as in the Door Hardware Schedule at the end of Part 3.
3. Content: Include the following information:
   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.
   h. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
      i. Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.
4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
5. Hardware Schedule Index: Furnish an index cross-referencing door number, Architect's hardware group, and supplier's hardware group.

F. Keying Schedule: Prepared by or under the supervision of supplier, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

G. Product Certificates: Signed by manufacturers of electrified door hardware certifying that products furnished comply with requirements.
   1. Certify that door hardware approved for use on types and sizes of labeled fire doors complies with listed fire door assemblies.

H. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
   1. Include lists of completed projects with project names and addresses of architects and owners, and other information specified.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, indicating current products comply with requirements.

J. Maintenance Data: For each type of door hardware to include in maintenance manuals specified in Division 1.

K. Warranties: Special warranties specified in this Section.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Supplier Qualifications: Door hardware supplier with warehousing facilities in Project's vicinity and who is or employs a qualified Architectural Hardware Consultant, available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
   1. Electrified Door Hardware Supplier Qualifications: An experienced door hardware supplier who has completed projects with electrified door hardware similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in—service performance, and who is acceptable to manufacturer of primary materials.
      a. Engineering Responsibility: Prepare data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
   2. Scheduling Responsibility: Preparation of door hardware and keying schedules.

C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
   1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that are listed to perform electrical modifications, by a testing and inspecting agency acceptable to authorities having jurisdiction, are acceptable.

D. Regulatory Requirements: Comply with provisions of the following:
   1 Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI Al 17.1, as follows:
      a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
      b. Door Closers: Comply with the following maximum opening-force requirements indicated:
         i. Interior Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
         ii. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
      c. Thresholds: Not more than 1/2 inch (13 mm) high. Bevel raised thresholds with a slope of not more than 1:2.
   2. NFPA 101: Comply with the following for means of egress doors:
      a. Latches, Locks, and Exit Devices: Not more than 15 lbf (67 N) to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
      b. Door Closers: Not more than 30 lbf (133 II) to set door in motion and not more than 15 1bf (67 I'd) to open door to minimum required width.
   3. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

E. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
   1. Test Pressure: Test at atmospheric pressure.

F. Keying Conference: Conduct conference at Project site to comply with

requirements in Division I Section "Project Meetings." incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
2. Preliminary key system schematic diagram.
3. Requirements for key control system.
4. Address for delivery of keys.

G. Pre-Installation Conference: Conduct conference at Project site. Review methods and procedures related to electrified door hardware including, but not limited to, the following:

1. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades.
2. Review sequence of operation for each type of electrified door hardware.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review required testing, inspecting, and certifying procedures.

1.4 DELIVERY, STORAGE AND HANDLING

A. Inventory door hardware on receipt and provide dry, secure lock-up for door hardware delivered to Project site.

B. Provide a packing list and a copy of the approved Door Hardware Schedule for each shipment of detention hardware. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package. Include necessary screws, keys, and templates.

C. Prior to scheduled completion of the Project, deliver keys to Owner’s representative by registered mail or other secure means.

1.5 COORDINATION

A. Assume sole responsibility for provision, coordination, and function of security hardware required for every opening, whether or not listed in the schedule of hardware.

B. Coordinate layout and installation of hardware with adjacent construction, including, but not limited to, door’s and frames. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

C. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing door hardware, including electronic security devices. Prior to ordering products, check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements, and that products selected will properly fit.

D. Electronic Security System and Hardware: Coordinate layout and installation of electrified door hardware and security system devices with connections to power supplies and security system for proper operation.

1.6 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
   1. Structural failures including excessive deflection, cracking, or breakage.
   2. Faulty operation of operators and door hardware.
   3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

C. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.
   1. For the first 24 months of the warranty period, maintain or replace at no cost to the Owner, any material failing to perform in accordance with this Specification.
   2. After the first 24 months, and for the following 24 months, provide to the Owner for Owner’s installation, any material failing to perform in accordance with this Specification.

1.7 MAINTENANCE SERVICE AND OWNER INSTRUCTIONS

A. Manufacturer and supplier shall conduct a formal training course with the Owner’s security personnel. The course shall be given at the installation site or at a location agreed upon by the Owner.
   1. Provide a minimum of 80 hours of instruction, 40 of which shall be held prior to occupancy and the remaining 40 within two months following the completion of the maintenance period.
   2. Provide course emphasis on understanding system capabilities, routine preventive maintenance, and required security staff responses.
   3. Include a detailed training manual covering the items outlined above, for Owner’s use during instruction.

B. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and detailed maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

C. Maintenance Service: Beginning at Substantial Completion, provide twelve months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 PRODUCTS

2.1 GENERAL

A. Materials: All materials required for the Work shall be produced especially for security applications and conform to standards of the security equipment industry and other requirements specified herein.

B. Security Hardware: Furnishing and installation of all security hardware and all incidental

items required to make the system properly function as specified herein are responsibility of the detention equipment Installer.

C. Available Products and Manufacturers: "Basis of Design" products are those included in the Schedule of Hardware Groups at the end of Part 3 of this Section. No substitutions are allowed.

2.2 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in this Section and the Door Hardware Schedule at ae end of Part 3.
   1. Door Hardware Sets: Requirements for quantity, item, design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Schedule at the end of Part 3. Products are identified by descriptive titles corresponding to requirements specified in Part 2.
   2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
   3. Finish: All exposed hardware except closers shall be satin stainless steel, ANSI 630 (US32D). Closer finish shall match stainless steel. Items not available in stainless steel shall be furnished with a satin chrome finish ANSI 626 (US26D).

2.3 HINGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Basis of Design: Stanley
   2. Other Acceptable manufacturers:
      a. Brink Locking Systems.
      b. Folger Adam
      c. Southern Steel Company.

B. Standards: Comply with the following:
   1. Butts and Hinges: BHMA A156.1.
   2. Template Hinge Dimensions: BHMA A156.7.

C. Quantity: Provide the following, unless otherwise indicated:
   1. Two Hinges: For doors with heights up to 60 inches (1524 mm), an additional unit for every additional 30 inches (762mm) in height or fraction thereof, and an additional unit for doors over 36 inches (9l5mm) in width.

D. Template Requirements: Provide only template-produced units.

E. Hinge Base Metal: Unless otherwise indicated, provide the following:
   1. Stainless steel, with stainless-steel pin.

F. Hinge Options: Comply with the following where indicated in the Door Hardware Schedule or on Drawings:

   1. Hospital Tips: Slope ends of hinge barrel.
   2. Shear resistant studs
   3. 1/4-20 TORX drive (with safety stud).

4. Ball bearing or concealed bearing.

G. Fasteners: Comply with the following:
1. Screws: TORX head screws; machine screws (drilled and tapped holes) for metal doors. Finish screw heads to match surface of hinges.

2.4 LOCKS AND LATCHES, GENERAL

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Mechanical Locks and Latches: Medeco High Security Locks, Inc.
2. Electromechanical Locks and Latches:
a. Best — Stanley Security (Basis of Design)
b. Folger Adam Security Inc.: Assa Abloy.
c. Sargent Manufacturing Company; Assa Abloy
d. Schlage Lock Company; Allegion.
e. Southern Steel Co.

B. Standards: Comply with the following:
1. Mortise Locks and Latches: BHMA A156.13.

C. Certified Products: Provide door hardware listed in the following BHMA directories:
1. Mechanical Locks and Latches: BHMA's "Directory of Certified Locks & Latches."
2. Electrified Locking Devices.

D. Lock Functions: Function numbers and descriptions indicated in the Door Hardware Schedule comply with the following:
1. Mortise Locks: BHMA A156.13.

2.5 CYLINDERS AND KEYING

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Cylinders:
a. Medeco High Security Locks, Inc., NO SUBSTITUTIONS.
b. See Division 8 Section “Door Hardware” for cylinder and keying system requirements.
2. Key Quantity:
a. Six master keys per set.
b. Two change keys for each Mogul, plus 100 blanks.
c. Two change keys for each Medeco cylinder, plus 100 blanks.
d. Three cut Paracentric keys for each lock, plus 50 blanks.
3. Key Control Systems:
a. See Division 8 Section ‘Door Hardware”.

2.6 STRIKES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Electric Strikes:

a. Folger Adam Security Inc.
b. Locknetics Security Engineering; a Harrow Company.

c. Rutherford Controls Inc.; BEST — Stanley Security
d. Security Door Controls.
e. Von Duprin, Inc.; Allegion

B. Standards: Comply with the following:

1. Strikes for Bored Locks and Latches: BHMA Al56.2.
2. Strikes for Mortise Locks and Latches: BHMA A156.13.
3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
4. Electric Strikes: BHMA Al56.5.

C. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

2.7 OPERATING TRIM

A. For sliding door operation, as listed in the Schedule of Hardware Groups at the end of Part 3 of this Section.

2.8 CLOSERS

A. Manufacturers: Subject to compliance with requirements, provide products the following:
1. Surface-Mounted Closers:
a. LCN Closers; Allegion.
b. Stanley Commercial Hardware (Basis of Design)

B. Standards: Comply with the following:
1. Closers: BHMA A156.4.

2.9 STOPS AND HOLDERS

A. Wall/ Floor Stop Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
1. Basis of Design: Trimco Manufacturing.
2. Other Acceptable Manufacturers:
a. Hager Companies.
b. Rockwood Manufacturing Company.

B. Standards: Comply with the following:
1. Stops and Bumpers: BHMA A156.16.

C. Floor Stops: For doors, unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic.
1. Where floor or wall stops are not appropriate, provide overhead holders.

2.10 DOOR GASKETING, GENERAL

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hager Companies.
   2. National Guard Products, Inc. (Basis of Design)
   3. Pemko Manufacturing Co., Inc.
   4. Reese Enterprises, Inc.
   5. Zero International, Inc.

B. Standard: Comply with BHMA A156.22.

C. General: Provide continuous gasketing on exterior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
   1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
   2. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

D. Air Leakage: Not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.

E. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.
   1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke-labeled doors.

F. Fire-Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL 10B or NFPA 252.

G. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.

H. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

I. Gasketing Materials: Comply with ASTM D 2000 and AAMA 701/702.

2.11 THRESHOLDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hager Companies.
   2. National Guard Products, Inc. (Basis of Design)
   3. Pemko Manufacturing Co., Inc.
   4. Reese Enterprises, Inc.
   5. Zero International, Inc.

B. Standard: Comply with BHMA A156.21.

C. General:
   1 Fabricate with continuous grooved top surface.
   2 Provide ADAAG-compliant profile with bevel on each long edge and in lengths to suit

door openings.

3 Furnish with continuous channel anchors for casting into slab or with expansion devices, and with countersunk flat head machine screws, for attachments to substrates.

2.12 SLIDING DOOR OPERATORS AND HARDWARE

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Airteq Locking Systems.
2. Folger Adam.
3. Southern Steel Co. (Basis of Design)

B. Sliding Door Operators and Hardware: Provide complete sets consisting of rails, hangers, supports, bumpers, floor guides, and accessories indicated.
1. Motor operated devices with a "kick release" door operating and locking mechanisms with remote controls for unlocking.
2. Include control mechanisms and electrical components within horizontal housing.
3. Door Carriages: Furnish sliding door carriages with solid steel mechanized wheels with sealed ball or needle bearings mounted on hardened steel spindles.
   a. Include steel tracks in horizontal housing and bottom door guide to prevent door carriage from being dislodged.
   b. Door hanger assembly shall so engage the track that it cannot be lifted off or forced out of alignment.
4. Provide sealed bearings for the entire device including motor and all moving parts to minimize need for lubrication.
5. Housing: Provide horizontal housing above sliding door for protection of operating and locking mechanisms.
   a. Form front and top from one-piece 10-gauge sheet steel. Form back and bottom of housing from 3/16-inch open-hearth steel plate.
   b. Protect slots in bottom of housing with covering angles or channel to prevent entrance of contraband and foreign matter into the operating and locking mechanisms.
6. Fabrication: Fabricate items to be rigid, neat in appearance, and free of defects, warp or buckle. Accurately form metal to required sizes and profiles.
   a. Pre-assemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the Project site. Disassemble units only to extent necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.
   b. Form exposed work to true line and level with accurate angles and surfaces and straight, clean, and even edges. Ease exposed edges to a radius of approximately 1/32-inch unless otherwise shown. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.
   c. Weld corners and seams continuously and in accordance with the recommendations of AWS. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.
   d. Provide for anchorage of the type shown coordinated with ae supporting structure. Fabricate and space anchoring devices to provide adequate support for the intended use of the Work.
   e. Cut, reinforce, drill, and tap metal work indicated to receive security hardware and similar items of work. Cut holes in strict accordance with templates.

2.13 MISCELLANEOUS DOOR HARDWARE

A. Monitor Switch Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Sentrol (Basis of Design).
   2. Airteq Locking Systems.
   3. Southern Steel (Basis of Design)

B. Boxed Power Supplies: Modular unit in NEMA ICS 6, Type 4 enclosure; filtered and regulated; voltage rating and type matching requirements of door hardware served; and listed and labeled for use with fire alarm systems.

C. Door Position Switches: Magnetically operated, triple-biased, balanced type switch designed for concealed mounting.
   1. Provide built-in, end-of-line resistors as required by the security control system.
   2. At swinging doors, locate switches in lock jamb 6 inches from head of door.

2.14 FABRICATION

A. Manufacturer's Nameplate: Do not provide manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise approved by Architect.
   1. Manufacturer's identification will be permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA Al56.18 for finishes. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended. Provide Phillips flat—head screws with finished heads to match surface of door hardware, unless otherwise indicated.
   1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
   2. Steel Machine or Wood Screws: For ae following fire—rated applications:
      a. Mortise hinges to doors.
      b. Strike plates to frames.
      c. Closers to doors and frames.

2.15 FINISHES

A. Standard: Comply with BHMA A156.18.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable

variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. BHMA Designations: Unless noted otherwise, comply with base material and finish requirements indicated by the following:
   1. BHMA 630: Satin stainless steel, over stainless-steel base metal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance of door hardware.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: Comply with DHI Al l5 series.
   1. Surface-Applied Door Hardware: Drill and tap doors and frames according to SDI 107.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated, or required to comply with governing regulations:
   1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
   1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
   2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Key Control System: Place keys on markers and hooks in key control system cabinet, as determined by final keying schedule.

D. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to

operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
2. Door Closers: Adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of ae door.

B. Six-Month Adjustment: Approximately six months after date of Substantial Completion, Installer shall perform the following:

1. Examine and readjust each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.
2. Consult with and instruct Owner's personnel on recommended maintenance procedures.
3. Replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation of door hardware units.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Comply with Division 8 Section “Door Hardware” for additional demonstration and training requirements.

3.7 SCHEDULE OF SECURITY HARDWARE GROUPS: The Groups listed below indicate the items of hardware required for each opening. It is the Bidder’s responsibility to accurately furnish the proper sizes, quantities, weights, gauge, and Design Intents as required by these specifications and as recommended by the manufacturers involved.

Manufacturer List:

Code	Name
ABH	ABH
BY	By Related Section
CR	Corbin Russwin
DJ	Don-Jo
MA	Marks
MD	Medeco
NG	National Guard
SA	Sargent
BO	By Owner/ Others

Finish List:

Code	Description
15	Satin Nickel Plate
28	Aluminum Anodized (Clear)
32D	Satin Stainless Steel
626	Satin Chromium Plated
628	Satin Aluminum, Clear Anodized
630	Satin Stainless Steel
689	Aluminum Painted
AL	Aluminum
CL	Clear
US32D	Stainless Steel, Dull

Hardware Sets

Set 9 – Detention Mechanical Closet – Locking w/Louvers DHMD/ DHMF
Doors: 006A, 006B,

2	Continuous Hinge	By HDW Contractor	AL	ST
3	Rim Cylinder	195RF/26D	626	MA
3	Core	By HDW Contractor	626	MA
2	Overhead Stop	By HDW Contractor	689	DJ
2	Smoke Seal	By HDW Contractor @ Head & Jambs		NA
2	Door Sweep	By HDW Contractor		NA
1	Security Louver	per Mechanical		

Set 9.1 – Detention Mechanical Closet – Locking DHMD/DHMF
Doors: 006C, 131

2	Continuous Hinge	By HDW Contractor	AL	ST
3	Rim Cylinder	195RF/26D	626	MA
3	Core	By HDW Contractor	626	MA
2	Overhead Stop	By HDW Contractor	689	DJ
2	Smoke Seal	By HDW Contractor @ Head & Jambs		NA
2	Door Sweep	By HDW Contractor		NA
2	Continuous Hinge	By HDW Contractor	AL	ST
1	Removable Mullion	By HDW Contractor	689	BY
2	Exit Device	By HDW Contractor	630	DJ
3	Rim Cylinder	195RF/26D	626	MA
3	Core	By HDW Contractor	626	MA
2	Closer	By HDW Contractor	689	DJ
2	Overhead Stop	By HDW Contractor	689	DJ
2	Smoke Seal	By HDW Contractor @ Head & Jambs		NA
1	Mullion Seal	By HDW Contractor		NA
2	Door Sweep	By HDW Contractor		NA
1	Threshold	By HDW Contractor	AL	NA

Set 10 – Detention Sliding – DHMD/DHMF Sliding Remote release
Doors: 129, 132, 133, 141

1	Electric Locking System	316LX.b Sliding Door System	630	SO

2	Recessed Pull	214S	630	BO
1	Wiring Diagram	Furnished by Hardware Supplier		BY
1	Power Transfer	By HDW Contractor		PR
1	Door Position Switch	By HDW Contractor	WHITE	RCIN
1	Power Supply	By HDW Contractor		RC

Set 10.1 – Detention Swinging – DHMD/DHMF w/ Access Control
Doors: 134, 141, 142, 143, 144, 145, 146, 148

3	Hinges	IHTCB1995 SRS 4 ½ x 4 1x2 TORX SCREWS	US32D	ST
1	Solenoid Jamb Lock	1051E	630	BO
1	Raised Door Pull	212	630	TR
1	Door Stop	1214	626	DJ
1	Wiring Diagram	Furnished by Hardware Supplier		BY
1	Power Transfer	By HDW Contractor		PR
1	Door Position Switch	By HDW Contractor	WHITE	RCIN
2	Backup Battery	By HDW Contractor		BE
1	Power Supply	By HDW Contractor		RC

Set 10.2 – Detention Swinging – DHMD/DHMF w/ Access Control, intercom & remote release
Doors: 135A, 140A

3	Hinges	IHTCB1995 SRS 4 ½ x 4 1x2 TORX SCREWS	US32D	ST
1	Rim Cylinder	195RF/26D	626	BE
1	Core	By HDW contractor	626	BE
1	Electric Strike	By HDW contractor	630	RCIN1
	Door Stop	1214	626	DJ
1	Wiring Diagram	Furnished by Hardware Supplier		BY
1	Card Reader	By OIT/OWNER		
1	Intercom	By OIT/OWNER		
1	Remote Release	By OIT/OWNER		
1	Power Transfer	By HDW Contractor		PR
1	Door Position Switch	By HDW Contractor	WHITE	RCIN
2	Backup Battery	By HDW Contractor		BE
1	Power Supply	By HDW Contractor		RC

Set 10.3 – Detentions Swinging Passage
Doors: 135B, 135C, 136, 140B, 140C

3	Hinges	IHTCB1995 SRS 4 ½ x 4 1x2 TORX SCREWS	US32D	ST
1	Passage Set	195N/26D	630	MA1
	Door Stop	1214	626	DJ
1	Door Position Switch	By HDW Contractor	WHITE	RCIN

Set 10.4 – Detention Swinging Access Control on both sides
Doors: 137A

3	Hinges	IHTCB1995 SRS 4 ½ x 4 1x2 TORX SCREWS	US32D	ST
1	Rim Cylinder	195RF/26D	626	BE
1	Core	By HDW contractor	626	BE

1	Electric Strike	By HDW contractor	630	RCIN1
	Raised Door Pull	212	630	TR
1	Door Stop	1214	626	DJ
1	Wiring Diagram	Furnished by Hardware Supplier		BY
2	Card Reader	By OIT/OWNER		
1	Power Transfer	By HDW Contractor		PR
1	Door Position Switch	By HDW Contractor	WHITE	RCIN
2	Backup Battery	By HDW Contractor		BE
1	Power Supply	By HDW Contractor		RC

Set 10.5 – Detention Swinging DHMD/DHMF Storage
Doors: 138, 139

1	Storeroom Lock	195RF/26D	630	MA
1	Core	By HDW contractor	626	BE
1	Closer	By HDW contractor	693	DM
1	Kick Plate	By HDW contractor	630	TR
1	Wall stop	By HDW Contractor		DJ
1	Door Sweep	By HDW contractor		NA

END OF SECTION 08 71 20

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
1. Aluminum Framed Entrances and Storefronts.
2. Aluminum Curtainwall.
3. Interior borrowed lites.

B. Related Sections:

1. Division 8 Section "Aluminum Curtainwall" for glass panels in exterior windows.

2. Division

3. Division 8 section "Aluminum Storefront" for glass panels in exterior and interior windows and doors

4. Division 8 Section "Fire Rated Glass and Framing" for fire-rated glazing.

5. Division 8 Section "Security Storefront Bullet Resistant Aluminum Framing" for bullet resistant glazing.

6. Division 8 Section "Bullet Resistant Aluminum Transaction Windows" for bullet resistant glazing.

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Design glass, including comprehensive engineering analysis according to ICC's 2015 International Building Code by a qualified professional engineer, using the following design criteria:

1. Design Wind Pressures: As indicated on Drawings.
2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.

3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.5 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. LEED Submittals:
1. Comply with Section 01 81 13
2. MR Credit 2: BPDO – Environmental Product Declarations (EPD):
   a. For each product.
   b. Glass if available.
3. MR Credit 4: BPDO – Material Ingredient Reports and/or Material Ingredient Optimization Reports and Action Plans.
   a. Health Product Declaration (HPD): For each product.

C. Glass Samples: For each type of the following products; 12 inches (300 mm) square.
1. Coated glass.
2. Fire-resistive glazing products.
3. Insulating glass.
4. Ballistic Glazing
5. Tempered Glass
6. Tempered Wire Glass
7. Tempered One Way Wire Glass

D. Glazing Accessory Samples: For gaskets and sealants in 12-inch (300-mm) lengths.

E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

F. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

G. Qualification Data: For installers manufacturers of insulating-glass units with sputter-coated, low-e coatings glass testing agency.

H. Product Certificates: For glass and glazing products, from manufacturer.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for coated glass, insulating glass, glazing sealants, and glazing gaskets.

J. Preconstruction adhesion and compatibility test report.

K. Warranties: Sample of special warranties.

1.6 INFORMATION SUBMITTALS

A. Qualification Data: For installers manufacturers of insulating-glass units with sputter-coated, low-e coatings glass testing agency.

B. Product Certificates: For glass and glazing products, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for coated glass, insulating glass, glazing sealants, and glazing gaskets.

D. Preconstruction adhesion and compatibility test report.

E. Warranties: Sample of special warranties.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

E. Source Limitations for Glass: Obtain coated float glass and insulating glass from single source from single manufacturer for each glass type.

F. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCCthe manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

I. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F (250 deg C), and the fire-resistance rating in minutes.

J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C).

1.10 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

1.11 ALTERNATES –

A. Add Alternate No. 1: The Amount to be added to the total contract sum in connection with increasing the base bid level 3 ballistic ratings at the first-floor exterior storefront system and glazing to level 5 ballistic rating, as shown on the architectural drawings.

B Add Alternate No. 2: The Amount to be added to the total contract sum in connection with providing level 5 ballistic rated storefront system and glazing to all second floor Type W-1 windows in lieu of the GL-1 glazing.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. GLAZING SCHEDULE:
1. GL-1 1” Insulated Low E tempered glass
2. GL-2 0.74” Nom. Thickness Impact Security Glazing: Clear 20-minutes of forced entry / physical attack protection
3. GL-3 Insulated Level 5 ballistic UL 752
4. GL-4 Insulated Level 3 ballistic UL 752
5. GL-5 3/16” 1-hr Fire Rating Glass at fire stair interior doors & sidelights.
6. GL-6 ¼” Clear Tempered Glass
7. GL-7 0.57” Nom. Thickness Impact Security Glazing: Clear 10-minutes of forced entry / physical attack protection
8. GL-8 1.01” Nom. Thickness Level 3 ballistic glazing UL 752
9. GL-9 0.74” Nom. Thickness Impact Security Glazing: One-Way-vision interlayer film in Clear 20-minutes of forced entry / physical attack protection

B. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0mm.

C. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. GL-6 Tempered, Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. For uncoated glass, comply with requirements for Condition A.
3. For coated vision glass, comply with requirements for Condition C (other coated glass).

2.3 INSULATING GLASS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. VITRO
2. Old Castle
3. Pilkington
4. Or equal as approved by Architect

B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary.
2. Spacer: Manufacturer's standard spacer material and construction
3. Desiccant: Molecular sieve or silica gel, or blend of both.

C. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Glass Types"

D. INSULATING-GLASS TYPES
1. GL-1 1” Insulated Low E

A. GL-1 Insulating Glass Unit Type 1: Low-e coated (VITRO Solarban 70XL) Clear insulating glass. Tinted Interlayer.

1. Overall Unit Thickness: 1” inch (25 mm)
2. Thickness of Each Glass Lite: ¼”, 6.0 mm
3. Outdoor Lite: Annealed glass
4. Interspace Content: Air
5. Interlayer: Tinted per spec
6. Indoor Lite: Fully tempered float glass
7. Low-e coating: Sputtered on second surface
8. Visible Light Transmittance: 64 percent minimum
9. Winter Nighttime U-Factor: 0.28 maximum.
10. Summer Daytime U-Factor: 0.26 maximum.
11. Solar Heat Gain Coefficient: 0.27
12. Shading Coefficient: 0.32
13. Provide safety glazing labeling.

B. See Ballistic Glazing for insulated ballistic glazing-

2.4 INTERIOR GLAZING

A. INTERIOR GLAZING - HEAT-TREATED FLOAT GLASS:
1. ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

B. GL-6
1. Glass Type - Interior: Clear fully tempered float glass.
2. Thickness: ¼”

2.5 BALLISTIC GLASS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Reference Section Ballistic Framing Systems & Bullet-Resistant Aluminum Transaction Windows.

C. Basis of Design McGrory & Insulguard
1. Or equal as approved by Architect

D. GLAZING TYPE
1. GL-3 1.717” Nom. Thickness Insulated Level 3 ballistic UL 752 SEE 08 43 44.13
a. Basis of Design: Baluln25 IG, by Insulgard Security products
b. Thickness: 1.717” Nom.
2. GL-4 ADD ALTERNATE #1 - 2.010” Nom. Thickness Insulated Level 5 ballistic UL 752 SEE 08 43 44.13
a. Basis of Design: Baluln32 IG, by Insulgard Security products
b. Thickness: 2.010” Nom.
c. GC is to have shop drawings coordinated with the change in frame depth and/or widths for all glazing elevations.
3. GL-8 1.01 Nom Thickness Level 3 ballistic UL 752 SEE 08 34 44 13 (interior)
a. Basis of Design: Baluln25, by Insulgard Security products
b. Thickness: 1.01” Nom.
c. Light Transmittance: 77%
d. U-Value: .84
e. SHGC: .63
f. Shading Coefficient: .72

4. Allowable Tolerances: Plus or minus 1/4 inch for frame opening width, height, diagonal dimensions, and overall width and height (outside to outside).

2.6 FIRE-PROTECTION-RATED GLAZING

A. GL-5 Fire-resistance-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies. GC is to coordinate with rated hollow metal door vision lites.

B. Monolithic Ceramic Glazing: Clear, ceramic flat glass; 7/8” nominal thickness.

C. Composition: Composed of multiple sheets of “Optiwhite” (BOD or equal) high visible light transmission glass laminated with an intumescent interlayer.

D. Properties:
1. Thickness: For Interior Use: 7/8”, #60-101.
1. Weight: Varies with thickness (approximate range 9 to 22 lbs./sq. ft.).
2. Approximate Visible Transmission: Varies with thickness (approximate range 88 to 75 percent).
3. Fire-rating: 60 minutes
4. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).

E. Permanently label each piece of with the appropriate marking per code including, W60

F. Fire Rating – 60 Minutes and Greater: Fire rating classified and labeled by UL for fire rating scheduled at opening locations on drawings, when tested in accordance with ASTM E 119 and UL 263.

G. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Basis for Design: Technical Glass Products; Pilkington Pyrostop
b. Safti First; SuperLite II-XL60.
c. Schott North America, Inc, Pryan Platinum

2.7 IMPACT SAFETY-RATED GLAZING

A. GL-2 0.74" Nom. Thickness Impact Security Glazing: Clear 20-minutes of forced entry / physical attack protection. General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, meeting ASTM F1915 Grade 3, 20-minute attack rated.
   a. Basis of Design: ¾" Clear AttackDefend 20 by McGrory Glass or approved equal
   b. Thickness: .75" Nom.
   c. Light Transmittance: 75%
   d. U-Value: .76

B. GL-7 0.57" Nom. Thickness Impact Security Glazing: Clear 10-minutes of forced entry / physical attack protection, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, meeting ASTM F1915 Grade 4, 10-minute attack rated.
   a. Basis of Design: 1/2" Clear AttackDefend 10 by McGrory Glass or approved equal
   b. Thickness: 0.57" Nom.
   c. Light Transmittance: 86%
   d. U-Value: .88

C. GL-9 0.74" Nom. Thickness Impact Security Glazing: One-Way-vision interlayer film in Clear 20-minutes of forced entry / physical attack protection. General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, meeting ASTM F1915 Grade 3, 20-minute attack rated.
   a. Basis of Design: ¾" Clear AttackDefend 20 by McGrory Glass or approved equal
   b. Thickness: .75" Nom.
   c. Light Transmittance: 75%
   d. U-Value: .76
   e. Provide one way vision film interlayer

2.8 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM, silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.9 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.10 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.11 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.12 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.

4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08 80 00

SECTION 08 83 00 - MIRRORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.1 SUMMARY

A. Section includes the following types of silvered flat glass mirrors:
   1. Frameless Tempered glass mirrors qualifying as safety glazing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to other work.

C. Samples:
   1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.
   2. Mirror Clips: Full size.
   3. Mirror Trim: 12 inches long.

1.3 INFORMATIONAL SUBMITTALS

A. Preconstruction test reports.

B. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Glazing Publications: Comply with GANA's "Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

B. Safety Glazing Products: For tempered mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.

C. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing and substrates on which mirrors are installed.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which mirror manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: Five years from date of Substantial Completion

PART 2 - PRODUCTS

2.1 SILVERED FLAT FRAMELESS GLASS MIRRORS

A. Glass Mirrors, General: ASTM C 1503

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Arch Aluminum & Glass Co., Inc.
b. Avalon Glass and Mirror Company.
c. Binswanger Mirror; a division of Vitro America, Inc.
d. D & W Incorporated
e. Donisi Mirror Company.
f. Gardner Glass, Inc.
g. Gilded Mirrors, Inc.
h. Guardian Industries.
i. Head West.
j. Independent Mirror Industries, Inc.
k. Lenoir Mirror Company.
l. Maran-Wurzell Glass & Mirror.
m. National Glass Industries.
n. Stroupe Mirror Co., Inc.
o. Sunshine Mirror; Westshore Glass Corp.
p. Virginia Mirror Company, Inc.
q. Walker Glass Co., Ltd.

B. Tempered Clear Glass: Mirror Glazing Quality, for blemish requirements; and comply with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied.
1. Nominal Thickness: 1/4 inch
2. Size: As indicated on the drawings.

2.2 MISCELLANEOUS MATERIALS

A. Edge Sealer: Approved by mirror manufacturer.

B. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors.

C. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.3 FABRICATION

A. Cutouts: Fabricate cutouts before tempering for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

B. Mirror Edge Treatment: Flat polished. Seal edges of mirrors with edge sealer.
1. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

C. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint as recommended in writing by film-backing manufacturer.

2.4 MIRROR HARDWARE

A. Mirror Bottom and Top Clips: Continuous aluminum clip. Provide side clips for end of mirrored walls.

B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

1. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers.
2. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

B. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

C. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

D. Wall-Mounted Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
   1. Mirror Clips: Place a felt or plastic pad between mirror and each clip to prevent spalling of mirror edges. Locate clips so they are symmetrically placed and evenly spaced.
   2. Mount mirrors a maximum of 40” above finish floor to reflective surface – above continuous clips.

E. Protect mirrors from breakage and contaminating substances resulting from construction operations.

F. Do not permit edges of mirrors to be exposed to standing water.

G. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

H. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 08 83 00

SECTION 09 21 16.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Gypsum board shaft wall assemblies.

B. Related Requirements:

1. Division 05 Section "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.

1.3 ACTION SUBMITTALS

A. Product Data: For each component of gypsum board shaft wall assembly.

B. Sustainable Design Submittals: Comply with Division 01 Section "Sustainable Design Requirements – LEED".

1. MR Credit 2: Environmental Product Declarations

a. Gypsum board and steel framing

2. MR Credit 4: Material Ingredients

a. Report: Gypsum board, sound attenuation blanket, joint compound, if available

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and support them on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.

B. Do not install finish panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E90 and classified according to ASTM E413 by a testing and inspecting agency.

2.2 MATERIALS, GENERAL

2.3 GYPSUM BOARD SHAFT CEILING ASSEMBLIES

A. Fire-Resistance Rating: UL415 A 1hour & UL415B 2 hours.

B. STC Rating: Not required

C. Gypsum Shaftliner Board:

1. Type X: ASTM C1396/C1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, 1 inch thick, with double beveled long edges.

a. Products: Subject to compliance with requirements, provide one of the following:

1) American Gypsum; Shaft Liner.

2) CertainTeed Corp.; ProRoc Shaftliner.
3) Georgia-Pacific Gypsum LLC, Subsidiary of Georgia Pacific; ToughRock Fireguard Shaftliner.
4) Lafarge North America, Inc.; Firecheck Type X Shaftliner.
5) National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner.
6) USG Corporation; Sheetrock Brand Gypsum Liner Panel.

D. Non-Load-Bearing Steel Framing, General: Complying with ASTM C645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.

1. Protective Coating: Coating with equivalent corrosion resistance of ASTM A653/A653M, G40 unless otherwise indicated.

E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:

1. Depth: As indicated.
2. Minimum Base-Metal Thickness: 0.030 inch.

F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.

1. Minimum Base-Metal Thickness: 0.030 inch.

G. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

H. Elevator-Hoistway-Entrance Struts: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches, matching studs in depth, and not less than 0.033 inch thick.

I. Finish Panels: Gypsum board as specified in Division 09 Section "Gypsum Board”.

J. Sound Attenuation Blankets: As specified in Division 09 Section "Gypsum Board".

2.4 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.

B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Division 09 Section "Gypsum Board” that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater

than or equal to the design load, as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.

2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E1190 conducted by a qualified testing agency.

E. Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch minimum thickness of base metal (uncoated).

F. Acoustical Sealant: Division 07 Section “Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Division 07 Section "Applied Fire Protection."

B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.

B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.

1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
2. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.

D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.

E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.

F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

G. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.

H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.

I. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.4 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 21 16.23

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing systems for interior walls and soffits.
2. Suspension systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each product.

B. Sustainable Design Submittals:

1. MR Credit 2: Environmental Product Declarations
   a. Metal framing

2. MR Credit 4: Material Ingredients
   a. Report: Steel, if available

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

B. Evaluation reports for firestop deflection tracks.

1.4 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, the Steel Stud Manufacturers Association or the Supreme Steel Framing System Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance:
   1. Interior Non-Load-Bearing Wall Framing: Steel framing / studs shall be of a configuration and gauge to provide sufficient stiffness, as controlled by the maximum allowable horizontal deflection of L/360 of the wall height under a horizontal load of 10 lbf/sq. ft. in all areas (U.N.O.).

2. Soffit / Ceiling Framing: Vertical deflection of 1/360 of the horizontally projected span for live load and 1/240 for total loads in all areas.

B. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E119 by an independent testing agency.

C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

2.2 FRAMING SYSTEMS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:

1. ClarkDietrich (Basis-of-Design).
2. Marino\WARE.
3. National Gypsum Co.; Gold Bond Building Products Division.
4. Craco Manufacturing

B. Framing Members, General: Comply with AISI S220 for conditions indicated.

1. Steel Sheet Components: Comply with AISI S220 requirements for metal unless otherwise indicated
2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40 (Z120); or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.

a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.

C. Studs and Track: AISI S220.
1. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection
2. Depth: As indicated on Drawings.

D. High-Strength Steel Studs and Tracks: Roll-formed with surface deformations to stiffen the framing members.
1. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection.
2. Depth: As indicated on Drawings.

E. Slip-Type Head Joints: Where indicated, provide the following:
1. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
a. Basis-of-Design: MaxTrack Slotted Deflection Track by ClarkDietrich
b. Smarttrack Slotted Slip Track by Craco Manufacturing.
c. Approved equal

F. Firestop Deflection Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
   1. Basis-of-Design: Blazeframe DSL2 by ClarkDietrich
   2. Approved equal

G. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
   1. Minimum Base-Steel Thickness: 0.0188 inch

H. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
   1. Depth: 1-1/2 inches (38 mm).
   2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

I. Hat-Shaped, Rigid Furring Channels:
   1. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm)
   2. Depth: As indicated on Drawings.

2.3 SUSPENSION SYSTEMS

A. Seismic Requirements: Installed to ASTM C636 Seismic Design Category A, including the following.
   1. 12 ga. hanger wires, minimum.
   2. Hanger wires spaced 4ft on center, maximum, along main beams.
   3. Hanger wires supporting main beams must be wrapped around themselves a minimum of three full turns within a 3" length.
   4. Hanger wires shall not hang more than one-in-six out-of-plumb, unless a counter-sloping wire or horizontal brace is provided.

B. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

C. Hanger Attachments to Concrete:

   1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, AC58 or AC308 as appropriate for the substrate.

      a. Uses: Securing hangers to structure.
      b. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.

D. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

   1. Depth: 2-1/2 inches.

F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
2. Steel Studs and Tracks:

a. Minimum Base-Steel Thickness: 0.0269 inch (0.683 mm).

3. Hat-Shaped, Rigid Furring Channels: 7/8 inch (22 mm) deep.

a. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm).

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLATION OF FRAMING SYSTEMS

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Deflection tracks: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

    a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches (610 mm) o.c.
    a. Do not use furring channels for continuous insulation, unless specifically called out in drawings.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.3 INSTALLATION OF SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

    a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established under Performance Requirements paragraph.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Design installed to ASTM C636: Follow manufacturer’s Seismic installation instructions for Seismic Design Category A.

3.4 FIELD QUALITY CONTROL

A. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.1 SUMMARY

A. This Section includes the following:

1. Interior gypsum wallboard.
2. Tile backing panels.
3. Trim Accessories & Reglets
4. See Sheathing Specification for glass-matt gypsum boards.

1.2 DEFINITIONS

A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Comply with Section 01 81 13
   a. MR Credit 2: BPDO – Environmental Product Declarations (EPD): For each product.
   b. MR Credit 4: BPDO – Material Ingredient Reports and/or Material Ingredient Optimization Reports and Action Plans.
      1) Health Product Declaration (HPD): For each product.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Gypsum Board and Related Products:

a. American Gypsum Co.
b. G-P Gypsum Corp.
c. National Gypsum Company.
d. United States Gypsum Co.

2.2 INTERIOR GYPSUM WALLBOARD

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Gypsum.
2. Georgia-Pacific Gypsum LLC.
3. Lafarge North America Inc.
4. National Gypsum Company; basis of design
5. USG Corporation.

C. Gypsum Board: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

D. Gypsum Board, Type X: ASTM C 1396/C 1396M.
1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

E. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

F. Gypsum Wall Board for Ballistic wall detailing: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch nom.

2. Long Edges: Tapered.
3. To be used above the 1/2” nom thickness ballistic wall panel up to 6ft.

G. Hi-Abuse-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.

1. Core: 5/8 inch (15.9 mm), Type XP.
2. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
3. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
4. Soft-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
5. Long Edges: Tapered.
6. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

H. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.3 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, with manufacturer's standard edges.

1. Thickness: 5/8 inch (15.9 mm).
2. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc, Plastic, Paper-faced galvanized steel sheet.
2. Shapes:

    a. Cornerbead: Use at outside corners.
    b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.
    c. L-Bead: L-shaped; exposed long leg receives joint compound; use where required.
    d. Expansion (Control) Joint: Long flanges receive joint compound; use where required to relieve expansion/contraction at continuous planar runs in excess of allowable dimension and at crossings of building expansion/control joints. Confirm locations with Architect.
    e. Drywall reveal molding 1/2" x 1/2" non vented. Basis of Design Fry Reglet or equal
        1) Model #: DRM-50-50.
        2) Finish: Standard Powder Coat White

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

2.6 ACOUSTICAL SEALANT

A. As specified in Division 7 “Joint Sealants.”

B. For adhesives and sealants, indicate compliance with requirements for low-emitting materials.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other

conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.

C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

G. Attach gypsum panels to framing provided at openings and cutouts.

H. Form control and expansion joints with space between edges of adjoining gypsum panels.

I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

J. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.

1. Space screws a maximum of 12 inches o.c. for vertical applications.

K. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.3 PANEL APPLICATION METHODS

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.

2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of board.
    b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.

B. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

3.5 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:

1. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.
2. Level 5: Where indicated on the Drawings or listed below.
    a. All panel surface that will be exposed to view walls in the Lobby RM 002 & Community Rm 100

    b. Primer and its application to surfaces are specified in Division 9 "Painting".

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for painting when used as a painted coverboard.
1. Embed 2” (51 mm) wide fiberglass mesh tape in 90 minute gypsum setting type joint compound over all joints. Upon setting, apply a skim coat of setting compound over the panels to achieve a uniform, smooth finish over the entire area. Prime with exterior-grade primer and finish with two coats of exterior-grade paint.

END OF SECTION 09 29 00

SECTION 09 29 53 Partition Gap Closure

PART 1 – GENERAL

1.00 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.01 SECTION INCLUDES:

A. This section includes drywall accessories or noise control components featuring Basis of Design Mullion Mate® Series 40 Extruded Aluminum Partition Gap Closure or approved equal, as shown on the Architectural Drawings.

B. Related sections include the following:
   1. 08 43 13 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
   2. 08 80 00 GLAZING
   3. 09 29 00 GYPSUM BOARD

1.02 RELATED SECTIONS:

A. Section 1 Specification sections as it applies to work of this Section.
B. Finish Schedule or Finish Legend as it applies to work of this Section.

1.03 REFERENCES:

A. GENERAL
   1. Comply with applicable requirements of the following, except where more stringent requirements are indicated by building codes.
B. American Architectural Manufacturers Association (AAMA):
   1. AAMA 2604 – Specification for Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
C. American Society for Testing and Materials (ASTM)
   1. ASTM D2247 Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
   2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
   3. ASTM E1399/E1399M-97 Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems.
   4. ASTM E90-2016 Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
D. National Association of Architectural Metal Manufacturers (NAAMM)
   1. Metal Finishes Manual for Architectural and Metal Products

1.04 DESIGN/PERFORMANCE REQUIREMENTS:

A. All components of the Extruded Aluminum Partition Gap Closure shall be provided by one (1) Manufacturer to ensure single source responsibility and quality control.
B. Partition Gap Closure shall meet specified performance requirements listed in ASTM E1399/E1399M-97 for the joint width minimum and maximum dimension verification as well as the cyclic movement performance for Class IV – Combined movement which encompasses Seismic, Thermal and Wind Sway, movement at a cycling rate greater than or equal to 10 cycles per minute.
C. Sound Transmission Class (STC) up to STC 58 per ASTM E90-2016.
D. All materials are Class A rated per ASTM E84.

1.05 SUBMITTALS:

A. Submission must be made within ten (10) working days of the General Contract Award to avoid project delay.
B. Product Data: Submit Manufacturer's:
    1. Product Specifications
    2. Detail Drawings.
    3. Installation Instructions
C. Samples:
    1. Submit samples consisting of 12" long Extruded Aluminum Partition Gap Closure and finish Q-Panel as specified, as well as accessories.

1.06 QUALITY ASSURANCE:

A. Source Limitations:
    1. All components of the Extruded Aluminum Partition Gap Closures shall be provided by a single Manufacturer to ensure responsibility and quality control.
B. Manufacturer Qualifications:
    1. Manufacturer must have manufacturing and delivery capacity required for the project and shall have successfully completed at least ten (10) projects within the past five (5) years, utilizing systems, materials, and techniques as herein specified.
    2. Manufacturer must own and operate its own manufacturing facilities for all metal components. "Stick Built" or "Kit of Parts Systems" consisting of components from a variety of Manufacturers/Fabricators will not be considered or accepted.
    3. Manufacturer must own and operate its own painting and finishing facility to assure single source responsibility and quality control.
C. Installer Qualifications:
    1. Installers shall have a minimum of five (5) years of experience installing systems of similar type and scope as those specified in this section.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. All materials shall be protected during fabrication, shipment and installation to prevent damage to the finished work from other trades.
B. To avoid lasting deformation of the Extruded Aluminum Partition Gap Closure components when exposed to temperature and humidity extremes, store this material at or near room temperature. Allow a minimum of 48 hours for the product to adjust to internal room temperature and humidity conditions before installing the Extruded Aluminum Partition Gap Closure.

C. Store Extruded Aluminum Partition Gap Closure inside a well-ventilated area, away from uncured concrete and masonry, and protected from the weather, moisture, soiling, abrasion, extreme temperatures, and humidity.
D. Maintain environmental conditions (temperature, humidity and ventilation) within limits recommend by Manufacturer for optimum results. Do not install products under environmental conditions outside Manufacturer's recommendations.
E. Exercise care in loading, unloading, storing and installing units to preclude bending, warping, twisting and other surface damage.

1.08 WARRANTY:

A. Standard Warranty:
    1. Furnish Manufacturer's Standard Warranty of two (2) years for workmanship and for finish against defects in materials and/or workmanship.

B. Extended Workmanship Warranty:
    1. Furnish Manufacturer's Standard Workmanship Warranty (must be requested at time of quotation) may be extended up to a maximum of twenty (20) years from date of material shipment, when installed in accordance with Manufacturer's recommendations.
    2. Provide a one (1) year extension of the Standard Workmanship Warranty for a total of three (3) years coverage

C. Extended Finish Warranty:
    1. Furnish Manufacturer's Standard Finish Warranty (must be requested at time of quotation) may be extended up to a maximum of twenty (20) years from date of material shipment, when installed in accordance with Manufacturer's recommendations.
    2. Provide a one (1) year extension of the Standard Finish Warranty for a total of three (3) years coverage

1.09 SUBSTITUTIONS:

A. No substitutions are permitted for the Extruded Aluminum Partition Gap Closure.
B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00. Companies desiring to submit a proposal shall submit all descriptive information of the system proposed including photographs and Shop Drawings of at least ten (10) projects within the past five (5) years, utilizing systems, materials and techniques as herein specified.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Basis-of-Design: Subject to compliance with requirements, provide Mullion Mate® Series 40 Extruded Aluminum Partition Gap Closures manufactured by Gordon, Inc. For all inquiries contact:

Gordon, Inc.
5023 Hazel Jones Road
Bossier City, LA 71111
(800) 747-8954

sales@mullionmate.com

B. Or Approved Equal.
   a. Mull-It-Over Mullion Trim Cap
   b. Or other approved equal.

C. The listed Manufacturer shall not be construed as closing specifications to other prospective Manufacturers, but rather as establishing a level of quality in a metal system. Other systems may be submitted for approval, as provided for in the specifications at least ten (10) working days prior to submission of bids. Companies desiring to submit a proposal shall submit all descriptive information of the system proposed including photographs and Shop Drawings of at least ten (10) projects within the past five (5) years, utilizing systems, materials, and techniques as herein specified.

2.02 MATERIALS:

A. Provide metals free from surface blemishes where exposed to view in finished Extruded Aluminum Partition Gap Closures. Surfaces exhibiting pitting, seam marks, roller marks, stains, discolorations, or other imperfections on finished Extruded Aluminum Partition Gap Closures are not acceptable. All metal shall be of the highest commercial grade available.

B. Extruded Aluminum Partition Gap Closures are pre-assembled and spring-loaded to provide a tight fit for vertical junctures of partitions and window walls.

C. Materials:
   1. Aluminum extrusions: 6063-T5 or T6 temper alloy.
   2. Aluminum sheet, 3000 series alloy.

2.03 FABRICATION:

A. Provide Extruded Aluminum Extruded Aluminum Partition Gap Closures in specified lengths and size to fit specified openings.
   1. Specify Mullion Mate® 2 (Series 40) for openings 2” – 2-15/16”.
   2. Specify Mullion Mate® 3 (Series 40) for openings 3” – 3-15/16’’,
   3. Specify Mullion Mate® 4 (Series 40) for openings 4’’ – 4-15/16’’,
   4. Specify Mullion Mate® 5 (Series 40) for openings 5’’ – 6-15/16’’,
   5. Specify Mullion Mate® 7 (Series 40) for openings 7’’ – 9’’, or
   6. Specify Mullion Mate® 9 (Series 40) for openings 9” – 14”.

Single-Piece construction available in lengths up to sixteen (16) feet. Spliced conditions are available in lengths up to thirty (30) feet.

B. Provide Mullion Mate® End Caps in ten (10) foot lengths and widths to fit specified wall conditions.
   1. Mullion Mate® End Caps –
      a. Specify MMEC-375 for 3-3/4” walls.
      b. Specify MMEC-487 for 4-7/8” walls.
      c. Specify MMEC-600 for 6” walls.
      d. Specify MMEC-725 for 7-1/4” walls.
      e. Specify MMECBF-518 for 5-1/8” walls,
      f. Specify MMECBF-514 for 5-1/4” walls,
      g. Specify MMECBF-512 for 5-1/2” walls,
      h. Specify MMECBF-618 for 6-1/8” walls,

i. Specify MMECBF-812 for 8-1/2" walls.
j. Specify out-to-out wall width for custom-fit applications.

C. Caulk for Extruded Aluminum Partition Gap Closure is to be specified as follows:
1. ASTM C920 Type S, Grade NS, Class 35, Use NT, G, A.
2. Federal Specification TT-S-00230C Type II, Class A
3. NSF Nonfood Compounds Category Code P1

2.04 FINISHES:

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
B. All material shall be in a finish chosen from one of the following options:
1. Field Paintable
2. Factory Anodized
a. Standard satin clear anodized.
b. Custom color anodized.
3. Factory applied Powder Coating to match Standard Colors or Custom Color and gloss as required.
a. Factory finish with a 5-stage pretreatment with dried-in-place conversion coating followed by:
i. AAMA 2604, super durable compliant powder coating, with Antimicrobial Properties, which provide up to 99.9999% efficacy.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examination of Surfaces: Installer must examine conditions under which work is to be performed and must notify Contractor in writing of unsatisfactory conditions.
B. Verify that field measurements and block-out dimensions are as shown on Shop Drawings.

3.02 PREPARATION:

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the Manufacturer to achieve the best result for the project conditions.
C. To avoid lasting deformation of the Extruded Aluminum Partition Gap Closure components when exposed to temperature and humidity extremes, store this material at or near room temperature. Allow a minimum of 48 hours for the product to adjust to internal room temperature and humidity conditions before installing the Extruded Aluminum Partition Gap Closure.

3.03 INSTALLATION:

A. Extruded Aluminum Partition Gap Closures shall be inspected before installation to be free from dents, scratches, and other defects.
B. Install Extruded Aluminum Partition Gap Closures in accordance with Manufacturer's written Installation Instructions and Details.
C. Space Enclosure: Do not install any work until space is enclosed and weatherproofed, wet-work in space is completed and nominally dry, work above ceilings is complete, and temperature and humidity shall be continuously maintained at values near those of final occupancy.

3.04 CLEANING:

A. Follow Manufacturer’s cleaning instructions for specified finish.

3.05 PROTECTION:

A. Procedures: Advise the Contractor of procedures required to protect the finished work from damage during the remainder of the construction period.

END OF SECTION

SECTION 09 31 00 - CERAMIC TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. This Section includes the following:
   1. Porcelain Floor Tile.
   2. Porcelain Wall Tile

B. Related Sections include the following:

   1. Division 7 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
   2. Division 9 Section "Gypsum Board Assemblies" for substrates for ceramic tile.

1.3 DEFINITIONS

A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

B. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 PERFORMANCE REQUIREMENTS

A. A. Dynamic Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ANSI 137.1, section 9.6:

   1. Level Surfaces: DCOF 0.42 Wet.

B. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

   1. Level Surfaces: Minimum 0.6 Wet & Dry.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

D. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Assembled samples with grouted joints for each type and composition of tile and for each color and finish required, at least 12 inches (300 mm) square and mounted on rigid panel. Use grout of type and in color or colors approved for completed work.
3. Full-size units of each type of trim and accessory for each color and finish required.

E. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

F. Product Certificates: For each type of product, signed by product manufacturer.

G. Qualification Data: For Installer.

H. Material Test Reports: For each tile-setting and -grouting product.

1.6 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain all tile from one source or producer.

1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:

1. Joint sealants.
2. Metal edge strips.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1. Meeting Agenda to include, but is not limited to:

a. Tile and installation material compatibility.
b. Grouting Procedure.
c. Surface Preparation.
d. Maintenance and cleaning products and methods.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Store liquid latexes in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article.

C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:

1. As selected by Architect from manufacturer's full range.

D. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

E. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.

F. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 TILE PRODUCTS

CT-1
Manufacturer: Daltile
Collection: Linear
Color: 018=90 Artic White
Finish: Glossy
Size: 4” x 12”
Installation: Typical Wall, Horizontal One-Half Offset
Location: 125/126 Public Restrooms, 215.1 Captain’s Restroom

CT-2
Manufacturer: Crossville
Collection: Simpactico Cube

Color: LWT02.11224CUBG White
Finish: Glossy
Size: 12” x 24”
Installation: Accent Wall, Vertical Straight Stack
Location: 125/126 Public Restrooms, 215.1 Captain’s Restroom

CT-3
Manufacturer: GST
Collection: Tribeca
Color: Pure
Finish: Glossy
Size: 3” x 12”
Installation: Typical Wall, Horizontal One-Half Offset
Location: 112, 130, 222 Staff Restrooms

CT-4
Manufacturer: GST
Collection: Tribeca
Color: Pure
Finish: Matte
Size: 12” x 12”
Installation: Accent Wall, Vertical Straight Stack
Location: 112, 130, 222 Staff Restrooms

2.4 SETTING AND GROUTING MATERIALS

A. Available Manufacturers:
1. MAPEI Corporation, Basis of Design.
2. LATICRETE International Inc
3. Custom Building Products
4. Bonsal, W. R., Company
5. Bostik
6. DAP, Inc.

A. Dry-Set Portland Cement Mortar (Thin Set):

1. For wall applications, provide non-sag mortar that complies with ANSI A118.1

MAPEI Kerabond

B. Latex/Polymer Modified Portland Cement Mortar

1. For wall applications, provide non-sag, latex mortar that complies with ANSI A118.4

MAPEI Ultraflex 2

C. Large and Heavy Tile Mortar that complies with ANSI A118.4, A118.11

MAPEI Ultraflex LFT.

D. Professional grade, ready to use, specialty grout. Meets and exceeds specific tests in ANSI A118.3 and A118.6. For grout joint widths of 1/16”-1/2”

MAPEI Flexcolor CQ

GROUT COLORS:

GR-1
Manufacturer: Full Manufacturer’s Selection
Color:
Number:
Location: CT-1 and CT-2

GR-2
Manufacturer: Full Manufacturer’s Selection
Color:
Number:
Location: CT-3 and CT-4

2.5 SURFACE PREPARATION MATERIALS

A. Reduced-preparation, self-leveling underlayment for smoothing and repairing interior floors before the installation of floor coverings from feather edge to up to 2” (5 cm).; MAPEI, “Ultraplan Easy”; Basis of Design.
1. 1 MAPEI Ultraplan 1 Plus
2. MAPEI Primer T

B. Cementitious Patching Compound; MAPEI, “Mapecem Quickpatch”; Basis of Design

2.6 CRACK ISOLATION AND WATERPROOFING MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 (Waterproofing) and A118.12 (Crack Isolation) for standard performance and is recommended by the manufacturer for the application indicated.
1. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 3/16-inch (4-mm) nominal thickness; Schluter Systems L.P DITRA and KERDI-BAND

2. Liquid applied:
a. Premium Latex Based Waterproofing and Crack Isolation Membrane; fast setting, flexible, thin, load-bearing, waterproofing membrane system consisting of a premixed, quick-drying liquid latex, for installation under ceramic tile or complying with ANSI A118.10 and ANSI A118.12; and having IAMPO certification as a shower pan liner
b. MAPEI Mapelastic AquaDefense

Premixed, liquid-rubber, quick-drying crack-isolation membrane for installation under ceramic tile or stone in residential and commercial interior and exterior environments complying with ANSI A118.12 MAPEI Mapelastic CI

2.7 ELASTOMERIC SEALANTS

A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Division 7 Section "Joint Sealants."

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

1. Available Products:

a. Dow Corning Corporation; Dow Corning 786.
b. GE Silicones; Sanitary 1700.
c. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
d. Tremco, Inc.; Tremsil 600 White.
e. MAPEI Mapesil T; available in all 40 MAPEI grout colors

2.8 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Temporary Protective Coating: Product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) per ASTM D 87.
2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.
   a. MAPEI Ultracare Grout Release.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

MAPEI Ultracare products:

1. Heavy Duty Stone, Tile and Grout Sealer
2. Concentrated Tile and Grout Cleaner
3. Everyday Stone, Tile and Grout Cleaner

2.9 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

B. Provide concrete substrates for tile floors installed with [adhesives] [or] [thin-set mortar] that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.

1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.

2. Remove protrusions, bumps, and ridges by sanding or grinding.

C. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. Field-Applied Temporary Protective Coating: Where indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.

C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

F. Lay out tile wainscots to next full tile beyond dimensions indicated.

G. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Locate joints in tile surfaces directly above joints in concrete substrates.
2. Prepare joints and apply color sealants matching grout to comply with requirements in Division 7 Section "Joint Sealants.", at interior and exterior wall corners.

H. Grout tile to comply with the manufacturer’s requirements.

I. Install cementitious backer units and treat joints to comply with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.4 FLOOR TILE INSTALLATION

A. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.

B. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.5 WALL TILE INSTALLATION

A. Install types of tile designated for wall installations to comply with requirements in the Wall Tile Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.

B. Joint Widths: Install tile on walls with the following joint widths:

1. Porcelain Tile: 3/16 inch.

3.6 TILE BACKING PANEL INSTALLATION

A. Install cementitious backer units and fiber-cement underlayment and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.7 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.8 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.9 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
1. Remove grout residue from tile as soon as possible.

2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
3. Remove temporary protective coating/grout release by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 09 31 00

SECTION 09 50 00 – WOOD PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. Section Includes

1. WoodWorks Linear Veneered Open as Basis of Design.
2. Exposed grid suspension system.
3. Wire hangers, fasteners, main runners, cross tees, wall angle moldings and accessories.

B. Related Sections:

1. Section 09 53 00 - Acoustical Ceiling Suspension Assembly
2. Section 09 20 00 - Plaster and Gypsum Board
3. Section 09 22 16 - Non-Structural Metal Framing
4. Divisions 23 (15) - HVAC
5. Division 26 (16) Sections - Electrical Work

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):

1) ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

2) ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire

3) ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

4) ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

5) ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

6) ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels

7) ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

8) ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint

9) ASTM E 1264 Classification for Acoustical Ceiling Products

B. Hardwood Plywood & Veneer Association (HPVA)

C. International Building Code

D. ASHRAE Standard 62 1 2004 Ventilation for Acceptable Indoor Air Quality

E. NFPA 70 National Electrical Code

F. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures

G. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components

H. International Code Council-Evaluation Services Report - Seismic Engineer Report

1. ESR 1308 - Armstrong T-Bar or Dimensional Suspension

I. California Air Resources Board (CARB) compliant

J. LEED – (NOT REQUIRED) Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of ceiling unit and suspension system required.

B. Installation Instructions: Submit manufacturer's installation instructions as referenced in Part 3, Installation.

C. Samples: Minimum 3-1/2 inch or 5-1/2 inch samples of specified panel; 8 inch long samples of exposed wall molding and suspension system, including main runner.

D. Shop Drawings: Illustrating the layout and details of the ceilings. Show locations of items that are to be coordinated with, or supported by the ceilings.

E. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.

F. All products not conforming to manufacturer's current published values must be removed and dispose. Replace with complying product at the expense of the Contractor performing the work.

G. Sustainable Design Submittals: Comply with Division 01 Section “Sustainable Design Requirements – LEED”.

1. MR Credit 2: Environmental Product Declarations

    a. Acoustical product, wood veneer and steel suspension system, if available.

2. MR Credit 3: Sourcing of Raw Materials

    a. Recycled content: Ceiling tiles, steel suspension system.
    b. Bio-based: Ceiling tiles.
    c. Manufacturers with extended producer responsibility programs: Ceiling tiles.

3. MR Credit 4: Material Ingredients

    a. Report: Acoustical ceiling tiles and steel suspension system, if available.

4. EQ Credit 2: Low-Emitting Materials

    a. Acoustical Ceiling Tiles installed in building interior: Certificate stating compliance with California Department of Public Health (CDPH) Standard Method including TVOC range.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide ceiling panel units and grid components by a single manufacturer.

B. Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.

    a. Surface Burning Characteristics: As follows, tested per ASTM E-84 and complying with ASTM E 1264 for Class A products.

    b. HPVA (Hardwood Plywood and Veneer Association) certification and audit program per ASTM E-84 tunnel test.

C. Woodworking Standards: Manufacturer must comply with specified provisions of Architectural Woodworking Institute quality standards.

D. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

E. Woodworking Standards: Manufacturer must comply with specified provisions of Architectural Woodworking Institute quality standards.

F. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, wet work i.e. gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store the wood veneer ceiling panels in a dry interior location in their cartons prior to installation to avoid damage. Store the ceiling panel cartons in a flat, horizontal position. Do not remove the protectors between the panels until installation.

B. Do not store in unconditioned spaces with humidity greater than 55 percent or lower than 25 percent relative humidity and temperatures lower than 50 degrees F or greater than 86 degrees F. Do not expose the wood veneer ceiling panels to extreme temperatures, for example, close to a heating source or near a window with direct sunlight.

C. Handle ceiling units carefully to avoid chipped edges or damage to units in any way.

1.7 PROJECT CONDITIONS

A. Prior to installation, the wood veneer ceiling materials are required to reach room temperature and have stabilized moisture content for a minimum of 72 hours.

B. Do not install the wood veneer panels in spaces where the temperature or humidity conditions vary greatly from the temperatures and conditions that will be normal in the occupied space.

C. As interior finish products, the wood veneer panels are designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.

1.8 WARRANTY

A. Wood Veneer Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to:

1. Ceiling Panels: Defects in materials or factory workmanship

2. Grid System: Rusting and manufacturing defects

B. Warranty Period:

1. Wood veneer panels: Two (2) year from date of installation

2. Grid: Two (2) year from date of installation

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.9 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Ceiling Units: Furnish quantity of full-size units equal to 2.0 percent of amount installed.

2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 1.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Ceiling Panels Linear Veneered Open:

1. Armstrong World Industries, Inc. (Basis of Design
2. Other approved Manufacturer's
    a. Rulon International
    b. Hunter Douglas Woodwright

B. Suspension Systems:

1. Armstrong World Industries, Inc.

2.2 WOOD VENEER CEILING UNITS

A. Ceiling Panels Type (ACW-1):

1. Surface Texture: Smooth
2. Composition: Wood
3. Species/Finish: Grille Dark Cherry
4. Size: 12 in x 96 in
5. Reveal: Backer & Dowel
6. Profile:
7. Sabin:N/A
8. Edge Banding and Trim: To match face veneer
9. Noise Reduction Coefficient (NRC):ASTM C 423, Classified with UL label on product carton 0.75
10. Flame Spread: ASTM E84 HPVA Fire Classification (Fire Class)
11. Dimensional Stability: Standard
12. Basis of Design Product: WOODWORKS Linear Veneered Open, Item # 6460F01W1 as manufactured by Armstrong World Industries or approved equal

AWC-1	**(LINEAR VENEERED OPEN)**
Manufacturer:	Armstrong
Collection:	WOODWORKS Linear Veneered Open
Number:	6460F01W1
Size:	5 ¼" x 96"
Color:	Natural Variations Maple (NMP)

Shape: Plank
Perforation: W1 - Unperforated
Backer: BioAcoustics Beige-Matte
Acoustics: .50 NRC & CAC 26
Infill Panel: 5479
Fire Performance: Class A
Location: Lobby

B. Ceiling Accessories Linear Veneered Open:

1. Backer Clip - Item 5687
2. Tee Bar Hook – Item 5986
3. Wood Screws – Item 7123PKG300
4. Safety Cable – Item 6091
5. Support Hanger – Item SH12
6. Beam End Retaining Clip – Item BERC2
7. WoodWorks Linear Veneered Open Grid Tee Snap-in Clip – Item 5373

2.3 METAL SUSPENSION SYSTEMS

a) Components: All main beams and cross tees shall be commercial quality hot dipped galvanized steel as per ASTM A653. Main beams and cross tees are double-web steel construction with 15/16-inch type exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.

   1. Structural Classification: ASTM C635 (Heavy Duty)
   2. Color: Tech Black.
   3. Acceptable Product: 12’ HD Linear Carriers for 4-1/2” modules 5370, 12’ HD Linear Carriers for 6” modules 5371, Prelude XL 2’ Cross Tee XL7328BL (for discontinuous/cloud applications) as manufactured by Armstrong World Industries, Inc.
   4. 12-Gauge Hanger Wire – Item 7891

b) Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

c) Wire for Hangers and Ties: ASTM A641, Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least times-three design load, but not less than 12 gauge.

d) Accessories/Edge Moldings and Perimeter Trim:

   a. Shadow Molding (seismic) - Item7823
   b. Angle Molding – Item 7805
   c. WoodWorks Linear Veneered Open Grid Tee Snap-In Clip – Item 5373
   d. 4” Veneered Trim with 4 Clips – item 6481F07W1H4_ _ _ (Finish Suffix available: NWM, NWA, NOK, NPC, NWN, NVF, NRO, NQW, NQS, NWM) - W/Real Wood Edgebanding

e. 6” Veneered Trim with 4 Clips – item 6481F07W1H6_ _ _ (Finish Suffix available: NWM, NWA, NOK, NPC, NWN, NVF, NRO, NQW, NQS, NWM) - W/Real Wood Edgebanding

f.

g. 8” Veneered Trim with 4 Clips – item 6481F07W1H8_ _ _ (Finish Suffix available: NWM, NWA, NOK, NPC, NWN, NVF, NRO, NQW, NQS, NWM) - W/Real Wood Edgebanding

h. 4” Veneered Trim with 4 Clips – item 6481F01W1H4_ _ _ (Finish Suffix available: NMP, NLC, CWA, CRW) - W/Faux Wood Edgebanding

i. 6” Veneered Trim with 4 Clips – item 6481F01W1H6_ _ _ (Finish Suffix available: NMP, NLC, CWA, CRW) - W/Faux Wood Edgebanding

j. 8” Veneered Trim with 4 Clips – item 6481F01W1H8_ _ _ (Finish Suffix available: NMP, NLC, CWA, CRW) - W/Faux Wood Edgebanding

k. Axiom Slip Joint - AXSJ

l. Replacement Trim Clip – Item 5925

m. Adjustable Trim Clip – Item 7239

n. Axiom Vector Straight Trim - Recommend in Black 6” and up – AX_VESTR_ _ (Finish Suffix Recommended: BL, SG, MY)

o. Axiom Vector Curved Trim - Recommend in Black 6” and up – AX_VECUR_ _ (Finish Suffix Recommended: BL, SG, MY))

p. WoodWorks Edgebanding (Coordinating Faux Wood) – Item 6408_ _ _ (Finish Suffix available: All)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out.

B. Proper designs for both supply air and return air, maintenance of the HVAC filters and building interior space are essential to minimize soiling. Before starting the HVAC system, make sure supply air is properly filtered and the building interior is free of construction dust.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

A. Install suspension system and panels in compliance with ASTM C636; CISCA Seismic Guidelines; approved construction drawings; with the authorities having jurisdiction; and in accordance with the manufacturer's installation instructions.

B. Install wall moldings at intersection of suspended ceiling and vertical surfaces.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

SECTION 09 51 23 - ACOUSTICAL CEILING TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. This Section includes:

1. Acoustical ceiling tiles.
2. Acoustical ceiling framing systems.
3. Acoustical ceiling transitions.
4. Acoustical sealants.

1.3 DEFINITIONS

A. AC: Articulation Class.

B. CAC: Ceiling Attenuation Class.

C. LR: Light Reflectance coefficient.

D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sustainable Design Submittals: Comply with Division 01 Section "Sustainable Design Requirements – LEED".

1. MR Credit 2: Environmental Product Declarations

a. Acoustical ceiling tiles and steel suspension system, if available.

2. MR Credit 4: Material Ingredients

a. Report: Acoustical ceiling tiles and steel suspension system, if available.

C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:

1. Ceiling suspension members.
2. Method of attaching hangers to building structure.

    a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
4. Minimum Drawing Scale: 1/8 inch = 1 foot.

D. Samples for Initial Selection: For components with factory-applied color finishes.

E. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6-inch- square Samples of each type, color, pattern, and texture.
2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- long Samples of each type, finish, and color.

1.5 QUALITY ASSURANCE

A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.

B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

    a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
    b. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 WARRANTY

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

1. Acoustical Panels: Manufacturer’s defects in material.
2. Grid System: Rusting and manufacturer's defects.

B. Warranty Period:

1. Acoustical panels: Ten (10) years from date of substantial completion.
2. Suspension: Ten (10) years from date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.

2.2 ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 PANELS FOR ACOUSTICAL PANEL CEILINGS:

A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries or an approved equal.

1. Contact Information: Meredith Baxter, Armstrong Sales Manager – 717.881.2488.

B. ACT Armstrong World Industries, Inc. ceiling grid: Suprafine, XL 9/16”, white Grid System, Basis of Design.

C. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:

ACT-1

Manufacturer: Armstrong
Style: Ultima Lay-in and Tegular
Edge: Beveled Tegular 9/16”
Number: 1915LEC
NRC Rating: 0.75
CAC Rating: 35
AC Rating: 170
Color: White (WH)
Size: 24” x 48”
Grid: GR-1
Location: Typical

ACT-2

Manufacturer: Armstrong
Style: Dune
Edge: Beveled Tegular 9/16”
Number: 1777
NRC Rating: 0.55

CAC Rating: 35
AC Rating: NA
Color: White (WH)
Size: 24” x 48”
Location: Corridors & storage

ACT-3

Manufacturer: Armstrong
Style: Ultima Lay-in and Tegular
Edge: Beveled Tegular 9/16”
Number: 1929
NRC Rating: 0.75
CAC Rating: 35
Color: White (WH)
Size: 30” x 54”
Grid: GR-1
Location: Community Room

ACT-4

Manufacturer: Armstrong
Style: Ultima Health Zone
Edge: Beveled Tegular 9/16”
Number: 1936
NRC Rating: 0.70
CAC Rating: 38
AC Rating: NA
Color: White (WH)
Size: 24” x 24”
Location: Locker Rooms

ACT-5

Manufacturer: Armstrong
Style: Metalworks Securelock
Edge: Square Lay-In
Grid: Prelude XL 15/16” Exposed Tee
Number: 5488P4
NRC Rating: 0.85
CAC Rating: 38
AC Rating: NA
Color: White (WH)
Size: 24” x 24”
Location: Holding Areas all secure & detention
Grid: GR-2

2.4 PANELS SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

A. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

B. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated Carbon-Steel Wire: ASTM A 641, Class 1 zinc coating, soft temper.
2. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
3. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.

C. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

2.5 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILINGS.

A. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation, with prefinished 9/16-inch- (24-mm-)wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. Face Design: Flat, flush.
1. Cap Material: Prefinished galvanize steel in baked polyester paint.
2. Cap Finish: Painted White.

2.6 ACOUSTICAL SEALANT

B. Products:

1. Acoustical Sealant for Exposed and Concealed Joints:

a. Pecora Corp; AC-20 FTR Acoustical and Insulation Sealant.
b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

2. Acoustical Sealant for Concealed Joints:

a. OSI Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.
b. OSI Sealants, Inc.; Pro-Series SC-175 Rubber Base Sound Sealant.
c. Pecora Corp.; BA-98.
d. Tremco, Inc.; Tremco Acoustical Sealant.

C. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

2.7 METAL EDGE MOLDINGS AND TRIM

D. Extruded-aluminum edge moldings and trim: Where indicated, provide manufacturer's prefinished extruded-aluminum transitions of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces and attachment and other clips.

E. Basis-of-Design: Armstrong AXIOM Transitions
1. Vertical Ceiling transitions: AXTR#STR (# = height of transition in inches, as required)
2. 1 ½" wide Field transitions (change in grid orientation): AX15DSCSTR
3. Finish: to match ceiling grid.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION, GENERAL

A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in

form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:

   a. As indicated on reflected ceiling plans.

2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
3. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 23

SECTION 09 65 00 - RUBBER TILE FLOORING

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. Section Includes:

1. Athletic Rubber floor tile for the fitness room
   a. ECOmax for Fitness Vulcanized Composition Rubber Molded Tiles
   b. Quad Blok 4-3/4" x 4-3/4" Connector

2. Stair tread & landings.

B. Related Sections:

1. Division 09 Section "Resilient Tile Flooring".

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product including but not limited to the following information as applicable:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.
4. Maintenance recommendations.

B. Sustainable Design Submittals: Comply with Division 01 Section "Sustainable Design Requirements – LEED".

1. MR Credit 2: Environmental Product Declarations

   a. Resilient flooring, if available.

2. MR Credit 4: Material Ingredients

   a. Report: Resilient flooring, if available.

C. Samples: Full-size units of each color, texture, and pattern of floor tile required.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Minimum two years' experience and completed at least three projects of similar magnitude, material and complexity.

1.7 MOCKUPS

A. In-situ Mockup: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects and to set quality standards for materials, fabrication, and installation.

1. Size: 100 sq. ft.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged wrapping and/or containers with identification labels intact clearly marking edge type, thickness, percentage of speckle and shade of color(s).

B. Inspection: Inspect all deliveries to ensure undamaged goods, and for accurate product type for thickness, edge type, color and speckle. Contact manufacturer immediately if product is damaged or inconsistent with order specifications.

C. Storage and Protection: Carefully handle all materials and store protected from exposure to harmful weather and at temperature conditions recommended by the manufacturer. Remove pallet banding if long term storage is required, but leave other packaging intact until acclimation is to be started.

D. Flooring material and adhesive shall be acclimated to the installation area for a minimum of 24 hours prior to installation. See manufacturer's installation guidelines for details on proper acclimation process.

1.9 FIELD CONDITIONS

A. Environmental Requirements/Conditions: In accordance with manufacturer's recommendations. Areas to receive flooring shall be clean, level, dry, fully enclosed, weather tight with the permanent HVAC set at a uniform temperature of at least 68 deg. F degrees and less than 85 deg. F continuously prior to, during and after installation, but for not less than 48 hours prior to and during, and for not less than 48 hours after installation. The flooring material shall be conditioned in the same manner prior to installation.

B. Close spaces to traffic during rubber flooring installation and for a period of time after installation as recommended in writing by the manufacturer.

C. Install rubber flooring materials and accessories after all other finishing operations, including painting, have been completed.

D. Concrete substrates should not exceed 80 percent RH and/or 5 lbs. X 24 hrs. X 1000 sf. moisture vapor emissions rate tested in accordance to ASTM F 2170 and ASTM F 1869.

1.10 WARRANTY

A. Warranty Period: Manufacturer's standard (10) Year Warranty against manufacturing defects.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide ECOfit Plus Interlocking Tile rubber flooring by Ecosurfaces or comparable products by one of the following manufacturers, but not limited to:

1. Armstrong Flooring Inc.
2. Tarkett North America.
3. Dinoflex Group LP

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.3 ATHLETIC RECYCLED RUBBER FLOORING TILES

A. Material shall be manufactured from a composition of recycled truck tire crumb rubber encapsulated in a urethane binder.

B. All tiles shall be square edge tile. 15.2 mm thick; 23" x 23" (58 cm x 58 cm), Approximately 2.0 lbs /ft2 (.907 kg/ft2) Thickness tolerance is a maximum of +/- 0.5mm.

C. Edge finish and product size: Square (23” x 23”).

D. Thickness: 15.2mm.

E. Color: To be selected by Architect from standard color range.

2.4 HOMOGENEOUS PERFORMANCE COMPOUND RUBBER TILE FLOORING

A. Material shall be a non-vulcanized, non-laminated tile product with homogeneous color, composed of post-consumer recycled SBR (styrene butadiene rubber) combined with low odour EPDM (ethylene propylene diene monomer) rubber granules, bound with a proprietary slow-cured MDI water-based polymer.

B. All tiles shall be produced in block form (not cut from rolled material) sliced and precision cut using computerized numerically controlled (CNC) water-based equipment. Thickness tolerance is a maximum of +/- 0.5mm.

C. All Recycled Rubber Tiles shall be FloorScore(R) certified under the criteria developed by the Resilient Floor Covering Institute (RFCI) and certified by Scientific Certification Systems (SCS), Inc. Registration # SCS-FS-02144.

RT-2 Stair Landings
Manufacturer: Roppe
Style: ReNew
Color: R123 Charcoal
Finish: Smooth
Size: 50cm x 50cm
Location: Stair Landings in stairwells

RT-3 STAIR TREADS
Manufacturer: Roppe
Style: ReNew
Tread Style: #95 Hammered
Riser Style: Integral
Color: 123 Charcoal
Safety Strip: Almond
Location: Stair Treads in stairwells

2.5 ACCESSORIES

A. Provide adhesives according to manufacturer' recommendations and installation guidelines for specific substrate, and use only one of the following adhesives approved by the manufacturer:

1. Chemrex CX-941, one-component urethane, volatile organic compound (VOC) compliant. Chemrex Sealer/Primer to reduce vapor emissions over allowable levels
2. Bostik Green Fusion, one-component urethane, volatile organic compound (VOC) compliant
3. Or equal.

B. Portland based cementitious base leveler. Gypsum based not acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Ensure that substrate is dry and clean, and shall be free of depressions, raised areas or other defects that might telegraph through installed flooring.

B. Ensure that substrate is flat and uniformly sloped. Allowable variations in substrate levels are +/- 1/8” in 10’-0” and 1/4” total maximum variation from levels shown.

C. Concrete Substrates: Prepare according to ASTM F710.

1. Verify a minimum of 30 days prior to the scheduled resilient flooring installation the following substrate conditions. All substrate testing shall be documented and submitted to the Architect and Owner before commencement of the flooring installation.

a. Verify that substrates are dry, free of debris, and that all curing compounds, sealers, and hardeners have properly cured.
b. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
c. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
d. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover floor tile until Substantial Completion.

END OF SECTION 09 62 00

SECTION 09 65 13 - RESILIENT WALL BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. Section Includes:

1. Resilient wall base.
2. Accessories.

B. Related Sections:

1. Division 09 Section "Resilient Tile Flooring".

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Comply with Division 01 Section "Sustainable Design Requirements – LEED".

1. MR Credit 2: Environmental Product Declarations

a. Resilient base, if available

2. MR Credit 4: Material Ingredients

a. Report: Resilient base, if available

C. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

A. Installation Qualifications: Contractors for floor covering installation should be experienced in managing commercial flooring projects and provide professional installers, qualified to install the various flooring materials specified.

1.6 MOCKUPS

A. In-situ Mockup: Build mockups of each type of resilient base to demonstrate aesthetic effects and to set quality standards for materials, fabrication, and installation.

1. Size: (1) room of each type.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.8 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products listed elsewhere in Part 2 by Tarkett North America or comparable products by one of the following manufacturers, but not limited to

a. Armstrong Flooring Inc.
b. Roppe Corporation USA.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.3 MATERIALS, GENERAL

2.4 RESILIENT WALL BASE (RB-1)

A. Basis-of-Design Product: Tarkett Johnsonite Vinyl 1/8 (type TV).

B. Product Standard: Meets performance requirements for ASTM F1861 Standard Specification for Resilient Wall Base, Type TV, Group 1.

C. Profile: Traditional Toe Cove

D. Height: 4”

E. Thickness: 1/8”

F. Type: TV

G. Lengths: Cut lengths coils

H. Outside Corners: Jobformed

I. Inside Corners: Job formed.

J. Color: 20 Charcoal WG

K. Test Data:

1. Resistance to light, ASTM F1515: Passes
2. Resistance to chemicals, ASTM F925: Passes
3. ASTM E 648, Standard Test Method for Critical Radiant Flux of 0.45 watts/cm^2 or greater, Class 1.

2.5 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible.

a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible.

a. Miter or cope corners to minimize open joints.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.

1. Apply manufacturer’s recommended number of coats.

E. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 65 13

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management’s general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. Section Includes:

1. Luxury Vinyl Tile (LVT)

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Comply with Division 01 Section “Sustainable Design Requirements – LEED”.

1. MR Credit 2: Environmental Product Declarations

a. Resilient flooring, if available.

2. MR Credit 4: Material Ingredients

a. Report: Resilient flooring, if available.

C. Samples: Full-size units of each color, texture, and pattern of floor tile required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 12 inches long, of each color required.

D. Product Schedule: For floor tile.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 MOCKUPS

A. In-situ Mockup: Build mockups of each LVT and VCT color and style to demonstrate aesthetic effects and to set quality standards for materials, fabrication, and installation.

1. Size: (1) room of each type.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

1.9 WARRANTY

A. Standard Warranty:
1. Furnish Manufacturer’s Commercial Limited Warranty of five (5) year finish against defects in materials.
2. Furnish installed Workmanship Warranty of Two (2) year for workmanship against defects in workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products listed elsewhere in Part 2 by ShawContract or comparable products by one of the following manufacturers, but not limited to

1. Armstrong Flooring Inc.
2. Tarkett North America.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.3 LUXURY VINYL TILE (LVT)

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products listed below by ShawContract or comparable products by one of the following manufacturers, but not limited to

1. Armstrong Flooring Inc.
2. Tarkett North America.

LVT-1
Manufacturer: Shaw Contract
Collection: Dialogue
Pattern: Coded 4143V
Color: Engage 43595
Size: 6 in x 48 in
Location: Typical, see plan and schedule

LVT-2
Manufacturer: Shaw Contract
Collection: Compound + Cast
Pattern: Compound 5.0 4077V
Color: Granite 77585
Size: 24 in x 24 in
Location: Accent in corridors

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing.
4. Moisture Testing: Perform tests so that each test area does not 1000 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles in pattern of colors and sizes indicated.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply manufacturer's recommended number of coats.

E. Cover floor tile until Substantial Completion.

END OF SECTION 09 65 19

SECTION 09 66 23 - RESINOUS MATRIX TERRAZZO FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management’s general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. Section Includes:

1. Thin-set, epoxy-resin terrazzo flooring.
2. Thin-set, integral epoxy terrazzo base.
3. Thick-set, precast epoxy terrazzo stair tread and riser units.

B. Related Requirements:

1. Division 07 Section "Joint Sealants" for sealants installed with terrazzo.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to terrazzo including, but not limited to, the following:

a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
c. Review special terrazzo designs and patterns.
d. Review dust-control procedures.
e. Review detail conditions at all penetrations, terminations, and perimeter conditions.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include terrazzo installation requirements. Include plans, sections, component details, and relationship to other work. Show layout of the following:

1. Divider strips.

2. Control-joint strips.
3. Accessory strips.
4. Abrasive strips.
5. Stair treads, risers, and landings.
6. Precast terrazzo jointing and edge configurations.
7. Terrazzo patterns.

C. Samples: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo Sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in sizes indicated below:

1. Terrazzo: 6-inch-square Samples.
2. Precast Terrazzo Base: 6-inch-long Samples.
3. Precast Terrazzo Stair Treads and Risers: 12-inch-long Samples.
4. Accessories: 6-inch-long Samples of each exposed strip item required.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Certificates: For each type of terrazzo material or product.

C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

D. Preinstallation moisture-testing reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For terrazzo to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Engage an installer who is a contractor member of NTMA.
2. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.
3. Engage an installer who has not less than ten years satisfactory experience in the application of resinous terrazzo flooring and continuous membership in the NTMA for the same period of time.
4. Engage an installer who has satisfactorily completed not less than three projects of similar complexity and scope to that specified for this project.

B. Manufacturer Qualifications: Manufacturer shall have not less than ten years satisfactory experience in the manufacture of resinous terrazzo flooring and continuous membership in the NTMA for the same period of time.

1.8 MOCKUPS

A. In-situ Mockup: Build mockups of each terrazzo application to demonstrate aesthetic effects and to set quality standards for materials, fabrication, and installation.

1. Size:

a. Minimum 100 sq. ft. of typical poured-in-place flooring and base condition for each color and pattern in locations directed by Architect.
b. Include minimum (3) stair treads and risers plus (1) intermediate landing.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.

B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.

C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.

D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.

E. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace terrazzo that fails in materials or workmanship within specified warranty period.

1. Warranty Period: (2) years from date of Substantial Completion.
2. Includes loss of bond and damage due to normal wear and tear.

B. Installer's Warranty: Installer agrees to repair or replace terrazzo that fails in materials or workmanship within specified warranty period.

1. Warranty Period: (2) years from date of Substantial Completion.
2. Includes loss of bond and damage due to normal wear and tear.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain primary terrazzo materials from single source from single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.

B. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:

1. Master Terrazzo Technologies, LLC.
2. Polymerica Incorporated.
3. Sherwin-Williams High Performance Flooring.

2.2 PERFORMANCE REQUIREMENTS

A. NTMA Standards: Comply with NTMA's written recommendations for terrazzo type indicated unless more stringent requirements are specified.

1. Comply with NTMA Technical Bulletin No. 36, Terrazzo Coefficient of Friction.

2.3 MATERIALS, GENERAL

A. Interior wet-applied primers, sealers, and coatings: Comply with emissions requirements of CDPH Standard Test Method

2.4 EPOXY-RESIN TERRAZZO

A. Epoxy-Resin Terrazzo: Comply with manufacturer's written instructions for matrix and aggregate proportions and mixing.

B. Thickness: 3/8 inch.

C. Mix Color and Pattern: Comply with NTMA's "Guide Specification for Epoxy Terrazzo" and manufacturer's written instructions for component proportions and mixing. Adjust mixes as required to match Architect's samples. The trial mix designs are based on the following:

1. TZ-1
   Manufacturer: Wausau Tile

Collection: Terrazzo Tile
Pattern: Reflections
Color: TZ301 Frost
Size: See plans
Location: Lobby:

D. Materials:

1. Moisture-Vapor-Emission-Control Membrane: Two-component, high-solids, high-density, low-odor, epoxy-based membrane-forming product produced by epoxy terrazzo manufacturer that reduces moisture emission from concrete substrate to not more than 3 lb of water/1000 sq. ft. in 24 hours.
2. Substrate-Crack-Suppression Membrane: Product of terrazzo-resin manufacturer, having minimum 120 percent elongation potential according to ASTM D412.

    a. Reinforcement: Fiberglass scrim.

3. Primer: Manufacturer's product recommended for substrate and use indicated.
4. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated and in color required for mix indicated.

    a. Physical Properties without Aggregates:

        1) Hardness: 60 to 85 per ASTM D2240, Shore D.
        2) Minimum Tensile Strength: 3000 psi per ASTM D638 for a 2-inch specimen made using a "C" die per ASTM D412.
        3) Minimum Compressive Strength: 10,000 psi per ASTM D695, Specimen B cylinder.
        4) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D1308.

            a) Distilled water.
            b) Mineral water.
            c) Isopropanol.
            d) Ethanol.
            e) 0.025 percent detergent solution.
            f) 1.0 percent soap solution.
            g) 5 percent acetic acid.
            h) 10 percent sodium hydroxide.
            i) 10 percent hydrochloric acid.
            j) 30 percent sulfuric acid.

    b. Physical Properties with Aggregates: For terrazzo blended according to manufacturer's recommendations with one part epoxy resin with three parts marble aggregate consisting of 60 percent No. 1 chips and 40 percent No. 0 chips that is ground and grouted to a 1/4-inch nominal thickness, and cured for 7 days at 75 deg F plus or minus 2 deg F and at 50 percent plus or minus 2 percent relative humidity.

        1) Flammability: Self-extinguishing, maximum extent of burning 1/4 inch according to ASTM D635.
        2) Thermal Coefficient of Linear Expansion: 0.0025 inch/inch per deg F according to ASTM C531.

5. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.

    a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C131/C131M.
    b. 24-Hour Absorption Rate: Less than 0.75 percent.
    c. Dust Content: Less than 1.0 percent by weight.

6. Finishing Grout: Resin based.

2.5 PRECAST EPOXY-RESIN TERRAZZO

A. Precast Terrazzo Base: Minimum 3/8-inch-thick, epoxy terrazzo units cast in maximum lengths possible, but not less than 36 inches. Comply with manufacturer's written instructions for fabricating precast terrazzo base units in sizes and profiles indicated.

1. Type: Coved with minimum 3/4-inch radius.
2. Top Edge: Radius edge with polished top surface.
3. Outside Corner Units: With finished returned edges at outside corner.
4. Color, Pattern, and Finish: Match adjacent poured-in-place terrazzo flooring.

2.6 STRIP MATERIALS

A. Thin-Set Divider Strips: L-type angle in depth required for topping thickness indicated.

1. Material: Brass.
2. Top Width: 1/8 inch.

B. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.

C. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:

1. Edge-bead strips for exposed edges of terrazzo.

2.7 MORTAR MATERIALS

A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.

B. Latex-Portland Cement Slurry Bond Coat: Latex additive (water emulsion), serving as replacement for any gauging water, combined at job site with prepackaged dry mortar mix supplied or specified by latex additive manufacturer.

1. Products: Provide the following:

    a. Liquid Component: Laticrete 4237 Thin-set Mortar Additive; Latecrete International. Inc.

b. Prepackaged Dry Mortar Mix: Laticrete 211 Crete Filler Powder; Laticrete International, Inc.

C. Latex-Portland Cement Mortar Bed: Latex additive (water emulsion), serving as replacement for any gauging water, combined at job site with prepackaged dry mortar mix supplied or specified by latex additive manufacturer.

2.8 MISCELLANEOUS ACCESSORIES

A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use.

1. Adhesives shall have a VOC content of 70 g/L or less.

B. Anchoring Devices:

1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.
2. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.

C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.

D. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.

E. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.

F. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; and is recommended by sealer manufacturer.

1. Surface Friction: Not less than 0.6 according to ASTM D2047.
2. Acid-Base Properties: With pH factor between 7 and 10.
3. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers," CDPH standard method version 1.2.

G. Joint Sealants: Recommended by terrazzo and sealant manufacturers and complying with requirements in Division 07 Section "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

3.2 PREPARATION

A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.

B. Concrete Slabs:

1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.

    a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written instructions.
    c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.

C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

D. Preinstallation Moisture Testing:

1. Testing Agency: Engage a qualified testing agency to perform tests.
2. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Moisture-Vapor-Emission Test: Maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours when tested according to ASTM F1869 using anhydrous calcium chloride.
    b. Relative Humidity Test: Maximum 75 percent relative humidity measurement when tested according to ASTM F2170 using in-situ probes.

3. Proceed with terrazzo installation only after concrete substrates pass moisture testing or after installation of moisture-vapor-emission-control membrane on substrate areas that fail testing.

E. Moisture-Vapor-Emission-Control Membrane: Install according to manufacturer's written instructions.

1. Install concrete substrates that fail preinstallation moisture testing.

F. Substrate-Crack-Suppression Membrane: Install to isolate and suppress substrate cracks according to manufacturer's written instructions.

1. Prepare and prefill substrate cracks with membrane material.
2. Install membrane at substrate cracks in areas to receive terrazzo.
3. Reinforce membrane with fiberglass scrim.

G. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.

1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

3.3 EPOXY-RESIN TERRAZZO INSTALLATION

A. Comply with NTMA's written recommendations for terrazzo and accessory installation.

B. Strip Materials:

1. Divider and Control-Joint Strips:

a. Locate divider strips in locations indicated and as recommend by manufacturer.
b. Install control-joint strips back to back and directly above concrete-slab control joints.
c. Install control-joint strips with 1/4-inch gap between strips, and install sealant in gap.
d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.

2. Accessory Strips: Install as required to provide a complete installation.

C. Apply primer to terrazzo substrates according to manufacturer's written instructions.

D. Broadcast aggregate evenly throughout topping mix to assure even distribution of aggregate in finished floor surface. Remove and reinstall panels of terrazzo exhibiting uneven distribution of aggregate upon direction of Architect.

E. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions.

1. Installed Thickness: 3/8 inch nominal.
2. Terrazzo Finishing: Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.

a. Rough Grinding: Grind with 24-grit or finer stones or with comparable diamond abrasives. Follow initial grind with 60/80-grit stones or with comparable diamond abrasives.
b. Grouting: Before grouting, clean terrazzo with water, rinse, and allow to dry. Apply and cure epoxy grout.
c. Fine Grinding: Grind with 120 or finer grit stones until all grout is removed from surface. Repeat rough grinding, grout coat, and fine grinding if large voids exist after initial fine grinding. Produce surface with a minimum of 70 percent aggregate exposure.
d. Repeat rough grinding, grout coat, and fine grinding if large voids exist after initial fine grinding. Produce surface with a minimum of 70 percent aggregate exposure.
e. Contractor shall be solely responsible for repairing any during the terrazzo finishing process.

3. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet; noncumulative.

3.4 PRECAST TERRAZZO INSTALLATION

A. Install precast terrazzo units using method recommended in writing by NTMA and manufacturer unless otherwise indicated.

B. Do not install units that are chipped, cracked, discolored, or improperly finished.

C. Seal joints between units with joint sealant.

3.5 REPAIR

A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

3.6 CLEANING AND PROTECTION

A. Cleaning:

1. Remove grinding dust from installation and adjacent areas.
2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.

B. Sealing:

1. Seal surfaces according to NTMA's written recommendations.
2. Apply sealer according to sealer manufacturer's written instructions.

C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION 09 66 23

SECTION 09 67 26 – DECORATIVE HIGH-PERFORMANCE FLOORING SYSTEM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.1 SECTION INCLUDES

Poured Epoxy Resin Flooring

A. Epoxy primer

B. Epoxy resin binder

C. Urethane finish coat

1.2 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete.

1.3 REFERENCES

A. ASTM C 307 - Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings.

B. ASTM C 413 - Absorption of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings.

C. ASTM C 579 - Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

D. ASTM D 696 - Coefficient of Linear Thermal Expansion of Plastics.

E. ASTM D-790 – Flexural Strength/Flexural Modulus of Elasticity

F. ASTM D-1644 – Determination of Solids Content

G. ASTM D-1044 – Abrasion Resistance by Tabor Abrasor

H. ASTM D 2240 - Rubber Property - Durometer Hardness.

I. ASTM D 4258 - Surface Cleaning Concrete for Coating.

J. ASTM D 4259 - Abrading Concrete.

K. ASTM C-413 - Water Absorption

L. ICRI Guideline 03732 – Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product data, including physical properties and colors available.

B. Manufacturer: Submit Manufacturer’s current ISO 9001 Certificate of Registration.

C. Product Samples: Submit Architectural Standard samples representative of the final finish, as applied. The Standard shall be approved in writing by the Architect and shall be the final standard of acceptance of the finish.

D. Maintenance Instructions: Submit manufacturer's maintenance instructions, including maintenance procedures and materials, procedures for stain removal and surface repair, and recommended schedule for cleaning.

1.5 QUALITY ASSURANCE

A. Qualifications:
1. Applicator: Use applicator experienced in application of specified materials for a minimum of [5] [Five] years on projects of similar size and complexity. Provide list of completed projects including project name and location, name of architect, name of material manufacturer, and approximate quantity of materials applied.
2. Applicator's Personnel: Employ only persons trained for application of specified materials.

B. Pre-application Meeting: Convene a pre-application meeting [2] [Two] weeks before start of application of floor coating. Require attendance of parties directly affecting work of this section, including Contractor, Architect, applicator, and manufacturer's representative. Review surface preparation, priming, application, curing, protection, and coordination with other work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name, manufacturer, batch or lot number, and date of manufacture. Do not store in direct sunlight or high heat conditions.

B. Storage:
1. Store materials in accordance with manufacturer’s instructions.
2. Keep containers sealed until ready for use.
3. Do not subject material to excessive heat or freezing; do not apply material that has been subjected to excessive heat or freezing. Material subjected to excessive heat or freezing shall be separated from inventory and destroyed by mixing all three components. The solid reacted product shall be disposed of in environmentally sound and regulatory compliant manner.
4. Shelf life: 1 [one] year after date of manufacture, in unopened containers, under normal conditions.

C. Handling: Protect materials during handling and application to prevent damage or contamination.

D. Condition materials for use to 60º – 85ºF (15º - 30ºC) for 24 hours prior to application.

1.7 SITE CONDITIONS

A. Do not apply materials if floor or air temperature is below 60ºF (15ºC).

B. Do not apply materials if relative humidity is above 85 percent or within 5º of dew point at time of application [Omit if not applicable]

C. Utilities, including electric, water, heat and finished lighting shall be supplied by General Contractor

D. Maintain room temperature between 60º – 85ºF (15º - 30ºC) for 48 hours before, during and 48 hours after installation, or until cured.

E. At the time of application ensure the minimum substrate temperature is above 60°F (15°C) and the substrate temperature is 5°F (3°C) above the measured dew point at the time of application. [Omit if not applicable]

F. Erect suitable barriers and post legible signs at points of entry to prevent traffic and trades from entering the work area during application and cure period of the floor.

G. Protection of finished floor from damage by subsequent trades shall be the responsibility of the General Contractor.

1.8 WARRANTY

A. Provide a warranty covering materials and workmanship for a period of two [2] year after date of substantial completion.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturer shall be certified under ISO 9001: All liquid materials, including primers, resins, curing agents, finish coats, and sealants are manufactured and tested under an ISO 9001 registered quality system.

C. Approved Manufacturer shall be Sika Corp., Industrial Flooring, 201 Polito Avenue, Lyndhurst, NJ 07071
Phone 201.933.8800
Fax 201.933.6225
usa.sika.com

D. Or approved equal.

2.2 SYSTEM

A. Description: Decodur Granite is a component based granite effect, flooring system that is designed to be installed between 80 – 100 mils/112 - 118 mils total system (primer/finish) thickness.

2.3 MATERIALS

A. Sikafloor® 161 Epoxy Primer
1. 100% solids, Low modulus, low viscosity, penetrating epoxy primer for concrete.
2. Apply in accordance with the Manufacturer's published technical data.
3. Optional Primers: Sikafloor 160 (low VOC), Sikafloor 1610 (high moisture concrete, Sikafloor 2570WB (water based). Consult Manufacturer's published technical data for applicable uses.

B. Sikafloor® 218DF/Decodur Granite Body Coat

1. Description: Two component, high solids epoxy for use as aggregate binder for Sikafloor Decodur Granite. Material shall only be applied in conjunction with Sikafloor DecoDur Granite specification aggregate, no other aggregates shall be used.
2. Apply in strict accordance with the Manufacturer's published technical data and instruction. Apply in one [1] application/coat at 80 – 100 mils (2.03 – 25.0mm)
3. Hardness: ASTM D-2240 80 (Shore D)
4. Bond Strength: ASTM D-4541 >400 psi (2.76 MPa) (100% concrete failure)
5. Tensile Strength: ASTM D-638 5,728 psi (27.4 MPa)
6. Compressive Strength: ASTM D-579 7,250 psi (34.7 MPa)
7. Impact Resistance: ASTM D-2794 160 in-lbs. (18.1 N-m)
8. Flexural Strength: ASTM D790 9,384 psi (44.9 MPa)
9. Abrasion Resistance: ASTM D-4060 76 mg loss (CS-17 wheel,1000 cycles)
10. Flammability (Base with any finish coat) ASTM E-648 Class I
11. Slip Resistance, Sikafloor 304W finish coat: ANSI A137.1 0.58 Wet/Dynamic

a. Engineered Resin Flooring (PE-1)
1. Color: to be selected by Architect

b. Engineered Resin Flooring (PE-2)
1. Color: to be selected by Architect

.

C. Sikafloor® 304W

1. Description: Clear, low VOC, clear, two-part, water based polyurethane, matte finish coat for use with Sikafloor Decodur Granite seamless flooring system.
2. Apply in accordance with the Manufacturer's published technical data.
3. Apply in one coat at 5 mils WFT.

B. Schedule of Poured Epoxy Resin Flooring
PE-1
Manufacturer: Sika Flooring

Collection: DecoDur Flake FX
Pattern: Contemporary Blends
Color: Pumicite
Size: 1/8” Flake
Location: 125/126 Public Restrooms, 215.1 Captain’s Restroom

PE-2
Manufacturer: Sika Flooring
Collection: DecoFlake
Pattern: Understated Style
Color: Sublime
Size: 1/8” Flake
Location: Staff Restrooms

PE-3
Manufacturer: Sika Flooring
Collection: DecoDur Flake FX
Pattern: Contemporary Blends
Color: Pebble
Size: 1/8” Flake
Location: Holding

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive Sikafloor® Decodur Granite system. Notify Architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions are corrected. Do not apply to substrate treatments for moisture, repair, or leveling not of the same Manufacturer.

B. Conduct quantitative moisture testing in accordance with ASTM-F2659-10 utilizing Tramex type impedance moisture meter. Maximum acceptable test result is 4%. If in excess of stated value, utilize Sikafloor® 1610 moisture tolerant epoxy primer, or PurCem® 24NA to produce acceptable coating surface. Adhere to Manufacturer’s published technical data and instruction.

C. Do not apply Sikafloor® Decodur Granite system to concrete less than 60 days old. Consult Technical Service prior to application when concrete has not cured for 60 days.

D. Do not apply Sikafloor® Decodur Granite system to sand-cement setting beds, regardless of condition. Sand-cement beds shall be removed to structural concrete substrate and re-leveled/sloped as necessary to achieve grade and/or adequate drainage.

E. Do not apply to asphaltic or bitumen membranes, soft wood, aluminum, copper or fiberglass reinforced polyester/vinyl ester composites.

F. Application to glazed or vitrified brick and tile, structural wood, or steel shall be approved only with the Manufacturer’s written recommendation.

3.2 UNDERLAYMENT TO CARPET BUILD-UP AREA

A. Sika Level-125, a one-component, durable and versatile cementitious underlayment for interior concrete and cementitious substrates, applied manually or by pump to produce a self-smoothing, rapid-set- ting, flat and economical substrate prior to the application of a final floor finish. Typical application thickness is 1/25 to 2 inches* (1 to 50 mm).

   a. Underlayment installed per manufacturer’s recommendations.

3.3 SURFACE PREPARATION

A. Prepare concrete surfaces in accordance with manufacturer's instructions and ASTM D 4258.

B. Remove dirt, oil, grease, wax, laitance, curing compounds, water-soluble concrete hardeners, and other surface contaminants.

C. Remove sealers, finishes, and paints.

D. Remove unsound concrete by scarifying, sand blasting, shot blasting, or high pressure water blasting.

E. Chemical Surface Preparation:

   1. Chemical surface preparation (acid etching) is unacceptable and will void Manufacturer’s warranty.

F. Mechanical Surface Preparation:

   1. Mechanically abrade concrete surface in accordance with manufacturer's instructions.
   2. Leave concrete surface with an aggressive texture.
   3. Remove concrete dust.
   4. Conform to ASTM D-4259.
   5. Surface profile shall conform to IRCI Guideline 03732 CSP 4, minimum.

3.3 CONTROL JOINTS, CRACKS

A. Provide repair and treatment of control joints and surface cracks utilizing manufacturer’s standard materials and installation details.

3.4 APPLICATION

A. Repair concrete substrate as required using SikaQuick® 1000 cementious repair/resurfacer in accordance with Manufacturer's instructions.

B. Do not add thinners to materials. No thinners shall be approved.

C. For coverage rates, consult data sheet for Sikafloor® Decodur Granite system

D. Finish surface to be smooth, with uniform texture, free of surface defects, and without porous areas.

E. Follow Manufacturer’s recommendations on terminations and connections to walls, drains, doorways,

columns and floor-to-floor transitions.

3.4 CLEANUP

A. Remove masking, draping, and other protection from adjacent surfaces.

B. Remove remaining materials and debris from job site and dispose of them in according with local rules and regulations. Leave area in clean condition free of debris.

3.6 PROTECTION

A. Protect Sikafloor® Decodur Granite system from damage after installation.

1. Foot Traffic: 12 to 16 hours.
2. Medium Wheeled Load 24 hours.
3. Full Cure: 72 hours

END OF SECTION 09 67 26

SECTION 09 68 10 - CARPET TILE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes modular construction carpet tile.

B. Related Sections include the following:
1. Division 9 Section "Resilient Floor Tile" for resilient wall base and accessories installed with carpet tile.
2. Division 9 Section "Carpet" for related areas.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.

B. LEED Submittals: Comply with Section 018113.
1. MR Credit 2: Environmental Product Declarations
   a. Carpet, if available
2. MR Credit 4: Material Ingredients
   a. Report: Carpet, if available

C. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Existing flooring materials to be removed.
3. Existing flooring materials to remain.
4. Carpet tile type, color, and dye lot.
5. Type of subfloor.
6. Type of installation.
7. Pattern of installation.

8. Pattern type, location, and direction.
9. Pile direction.
10. Type, color, and location of insets and borders.
11. Type, color, and location of edge, transition, and other accessory strips.
12. Transition details to other flooring materials.

D. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- (300-mm-) long Samples.

E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

F. Qualification Data: For Installer.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.

H. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

I. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

C. Mockups: Before installing carpet tile, build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to carpet tile installation including, but not limited to, the following:

1. Review delivery, storage, and handling procedures.
2. Review ambient conditions and ventilation procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."

B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.7 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excess static discharge, and delamination.
3. Warranty Period: 15 year wear warranty.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following listed Basis of Design Shaw Contract collections and style selections:

CPT-1
Manufacturer: Shaw Contract
Collection: Glimmer Tile
Pattern: 59329
Color: Flash Point 27485
Size: 24” x 24”
Installation: Ashlar
Location: Typ. Carpet

CPT-2A
Manufacturer: Interface
Collection: Woven Gradience
Product #: 13127
Color: Caribbean 108059
Size: 50cm x 50cm
Installation: See Drawing
Location: Community Room

CPT-2B
Manufacturer: Interface
Collection: Woven Gradience
Product #: 13127
Color: Linen 108048
Size: 50cm x 50cm
Installation: See Drawing
Location: Community Room

CPT-2C
Manufacturer: Interface
Collection: Woven Gradience
Product #: 13128
Color: Greige/Caribbean 107668
Size: 50cm x 50cm
Installation: See Drawing
Location: Community Room

CPT-2D
Manufacturer: Interface
Collection: Woven Gradience
Product #: 13127
Color: Navy 108061
Size: 50cm x 50cm
Installation: See Drawing
Location: Community Room

CPT-2E
Manufacturer: Interface
Collection: Woven Gradience
Product #: 13127
Color: Volcanic 108050
Size: 50cm x 50cm
Installation: See Drawing
Location: Community Room

CPT-2F
Manufacturer: Interface
Collection: Woven Gradience
Product #: 13128
Color: Volcanic/Navy 107669
Size: 50cm x 50cm
Installation: See Drawing
Location: Community Room

CPT-3
Manufacturer: Interface
Collection: Step Repeat
Product #: SR999
Color: 104943 Granite
Size: 50cm x 50cm
Installation: Quarter Turn
Location: Vestibule

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

1. Acceptable Manufacturers and Products:
   a. Sure Crete Design Products
      5246 Citrus Country Drive
      Dade City, FL 33523
      Tel: 352-567-7973
   b. UMACO
      60 Rear Newhall Street,
      Lowell, MA 01852
      Tel: 978=-453-8881.
      www.umaco.com

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

1. VOC Limits: Provide adhesives that comply with the following limits for VOC content when tested according to ASTM D 5116:

a. Total VOCs: 10.00 mg/sq. m x h.
b. Formaldehyde: 0.05 mg/sq. m x h.
c. 2-Ethyl-1-Hexanol: 3.00 mg/sq. m x h.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. For wood subfloors, verify the following:

1. Underlayment over subfloor complies with requirements specified in Division 6 Section "Rough Carpentry."
2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

C. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

D. For painted subfloors, verify the following:

1. Perform bond test recommended in writing by adhesive manufacturer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer - install every tile with full-spread, releasable, pressure-sensitive adhesive.

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern based on building design and installation efficiencies. Architect to approve layout before installation.

H. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 68 10

SECTION 097200 - WALL COVERINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.1 SUMMARY

A. Section Includes:

1. Vinyl wall covering.
2. Textile wall covering.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Job site, located at 901 Walker Ave, Catonsville, MD 21228.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement, seams, and termination points.

C. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 Warranty

A. Standard Warranty:

1. Furnish Manufacturer's Standard Warranty of Two (2) year or higher finish against defects in materials.
2. Furnish installed Workmanship Warranty of Two (2) year for workmanship against defects in workmanship.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates in accordance with test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: ASTM E84 Class A.
b. Smoke-Developed Index: ASTM E84 Class A.

2.2 VINYL WALL COVERING (VWC)

A. Manufacture: Momentum Textiles & Wallcoverings (basis of design) or approved equal.

B. Description: Provide vinyl products in rolls from same production run and complying with the following:

C. Width: **54 inches (1372 mm)**

D. Backing: **Paper**.

1. Fiber Content: 70% wood pulp, reinforced with 30% polyester

E. Repeat: **Random**

F. Retain "Mildew Resistance" Paragraph below if required. Both FS CCC-W-408D and ASTM F793/F793M stipulate this test and criterion for mildew resistance where specified.

G. Mildew Resistance: Rating of zero or 1 when tested in accordance with ASTM G21.

H. Colors, Textures, and Patterns: **As selected by Architect from manufacturer's full range**

VWC-1
Manufacturer: Momentum
Collection: Silvain
Product #: LSI-01
Color: Aqua
Location: 111, 227 Wellness Rooms

2.3 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining**[, strippable]** adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.

B. Primer/Sealer: Mildew resistant, complying with **requirements in Section 099123 "Interior Painting"** and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, and mildew.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
2. Plaster: Allow plaster to cure for at least 90 days. Neutralize areas of high alkalinity. Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
3. Metals: If not factory primed, clean and apply metal primer as recommended in writing by metal-primer manufacturer and wall-covering manufacturer.
4. Gypsum Board: Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
5. Painted Surfaces:

    a. Check for pigment bleeding. Apply primer/sealer to areas susceptible to pigment bleeding as recommended in writing by primer/sealer manufacturer.
    b. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.

D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.2 INSTALLATION OF WALL COVERING

A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.

B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.

C. Install strips in same order as cut from roll.

1. For solid-color, even-texture, or random-match wall coverings, reverse every other strip.

D. Install wall covering without lifted or curling edges and without visible shrinkage.

END OF SECTION 097200

SECTION 09 72 60 TACKABLE WALLCOVERING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.1 SUMMARY

A. Section Includes:
1. Resilient cork/linoleum tackable wallcovering.
2. Accessories.

B. Related Divisions:

1.	Division 09 91 23	Interior Painting: Priming for wallcoverings.
2.	Division 09 72 16.13	Flexible Vinyl Wallcoverings.
3.	Division 10 11 00	Visual Display Surfaces: Tackboards.

1.2 SUBMITTALS

A. Comply with Division 01 33 00.
B. Product data indicating compliance with specified requirements.
C. Installation Instructions.
D. Samples: 7 inch (18 centimeter) by 9 inch (23 centimeter) samples of each type of tackable wallcovering material required.

1.3 QUALITY ASSURANCE

A. Surface Burning Characteristics Classification: Provide materials that meet classification ratings below:
ASTM E84 (Flame Spread and Smoke Developed) II/B

B. Single Source Responsibility: Obtain tackable wallcovering system components from a single source.

C. Deliver materials in original factory packaging, labeled with manufacturer, brand name, size, color, and lot number.

D. Store materials in original, undamaged packaging inside a well-ventilated area protected from weather, moisture, soiling, and extreme temperatures.
Maintain room temperature within the storage area at not less than 68 degrees Fahrenheit (20 degrees Celsius) during the period materials are stored.

E. Mock-ups: Prepare mock-ups for architect's review and to establish requirements for seaming and finish trim.
1. Correct areas, modify method of application/installation, or adjust finish texture as directed by architect to comply with specified requirements.

2. Maintain mock-ups accessible to serve as a standard of quality.
3. Install sample panel of each type of wallcovering specified.
4. Install panels in areas designated by architect.
5. Mock up condition with aluminum trim and sample of pattern layout found in Break Room 209.

1.4 PROJECT CONDITIONS

Maintain ambient temperature within the building at not less than 68 degrees Fahrenheit (20 degrees Celsius) for a minimum of seventy-two hours prior to beginning of installation.

1. Do not install tackable wallcovering until the space is enclosed and weatherproof.
2. Do not install tackable wallcovering until temperature is stabilized and permanent lighting is in place.

1.5 MAINTENANCE

Maintenance Instructions: Include precautions against cleaning materials and methods that may be detrimental to finishes and performance.

1.6 WARRANTY

Submit manufacturer's limited five-year written warranty against manufacturing defects.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Tackable Wall Covering (BB)

Basis of Design: Tac-Wall® resilient, tackable, linoleum surface material. Walltalkers® Tac-Wall®: Uni-color resilient homogeneous tackable linoleum surface consisting of linseed oil, granulated cork, rosin binders, and dry pigments calendered onto natural burlap backing. Color shall extend through thickness of material or approved equal.

1. Width: 48 inch (122 centimeter)

2. Provide sacrificial ¼” MDF backer board, mechanically fastened to GWB walls and CMU walls, on all surfaces & locations that receive tackable wall coverings.

    1. Fasten to studs in GWB walls.

    2. Counter sink fasteners putty & sand smooth to prevent telescoping through tackable finish.

B. Gauge: 1/4 inch (6 millimeter). Approximately 95 lineal feet (29.1 meter) rolls. Flexible enough to bend around a 2-3/4 inch (7 centimeter) radius. Dimensionally stable due to burlap backing.

C. Products used, see drawings:

BB-1
Manufacturer: Koroseal
Style: Tac-Wall

Color: Stone
Number: SMS22041
Location: see interior elevations

BB-2
Manufacturer: Koroseal
Style: Tac-Wall
Color: Deep Sea
Number: SMS22141
Location: see interior elevations

BB-3
Manufacturer: Koroseal
Style: Tac-Wall
Color: Suntan
Number: SMS21661
Location: see interior elevations

2.2 ACCESSORIES

A. Adhesive: Solvent-free, SBR type linoleum adhesive (L-910W) or polyvinyl acetate dispersion type (contact adhesive) when used in a press.
B. Color matched caulk:
1. C100-04: Acrylic caulk stone.
2. C100-06: Acrylic caulk harbor.
3. C100-07: Acrylic caulk aztec.
4. C100-08: Acrylic caulk earthen.
5. C100-09: Acrylic caulk onyx.
6. C100-10: Acrylic caulk gypsy.
7. C100-11: Acrylic caulk cayenne.
8. C100-12: Acrylic caulk citrine.
9. C100-13: Acrylic caulk botanical.
10. C100-14: Acrylic caulk deep sea.
11. C100-62: Acrylic caulk pewter.
12. C100-66: Acrylic caulk suntan.
13. C100-82: Acrylic caulk quarry
14. C100-86: Acrylic caulk acorn
15. C100-87: Acrylic caulk sandalwood

C. J-Trim for Tac-Wall Provide for Community Message Board in the Vestibule RM 00.
JT12-00: Clear satin, anodized aluminum, 1/4 inch (6 millimeter) trim (old: JTRM-00).

PART 3 - EXECUTION

3.1 EXAMINATION

Examine areas and conditions in which tackable wallcoverings will be installed.
1. Complete finishing operations, including painting, before beginning installation of tackable wallcovering materials.
2. Wall surfaces to receive wallcovering materials shall be dry and free from dirt, grease, loose paint, and scale.
3. Notify the contractor and architect in writing of any conditions detrimental to the proper and timely completion of the installation.

4. Beginning of installation means acceptance of surface conditions.

3.2 PREPARATION

Surface Preparation: Remove hardware, accessories, plates, and similar items to allow tackable wallcovering to be installed.

1. Plaster surface: Remove surface chalk. In new work, use moisture meter to determine moisture content. Do not begin installation when moisture content is greater than five percent.
2. Gypsum board surface: Recess nails and screws. Repair irregular tape joints, sand and remove dust.
3. Painted surface: Remove loose paint or scale. Sand surface of enamel or gloss paint and wipe clean with damp cloth.
4. Ensure wall surfaces scheduled to receive tackable wallcovering are properly sealed with a quality primer specified for use under flexible vinyl wallcoverings.

3.3 APPLICATION

A. Comply with manufacturer's printed installation instructions.
B. Cut sheets to size including a few inches of overage. Allow sheets to lay flat for at least twenty-four hours prior to the application. Mark roll direction and sequence on the backside of each sheet. Hang sheets in sequence as cut from the roll, do not reverse sheets.
C. Permanent HVAC system should be set to 68 degrees Fahrenheit (20 degrees Celsius) for at least seventy-two hours prior to, during, and after the installation.
D. Back roll each sheet prior to the installation to release curl memory.
E. For seamed applications, using a seam and strip cutter remove the factory edge of one sheet. Using the same tool, overlap and trace cut the mating edge of the second sheet. Repeat this step for as many sheets as required for the job.
F. Scribe, cut, and fit material to butt tightly to adjacent surfaces, built-in casework, and permanent fixtures and pipes.
G. Apply adhesive with a 1/16 inch square notch trowel to the area to receiving the sheet (apply enough for one sheet at a time).
H. Work from top to bottom then side to side. Roll sheet firmly into adhesive for positive contact and to remove air bubbles.
I. Remove adhesive residue immediately after each panel is hung with a mild soap/water solution and a soft cloth/sponge.

JOINTS MAY BE BUTTED, V-GROOVED, SPACED WITH REVEAL, OR JOINED WITH DECORATIVE T-MOLDING.

3.4 CLEANING

A. Clean wallcovering using a sponge with a neutral pH cleaning solution. Do not use abrasive cleaners. Rinse thoroughly with water and let dry before using.
B. It is important to remove adhesive while wet.

3.5 PROTECTION

Protect installed product and finish surfaces from damage during construction.

END OF SECTION

SECTION 09 84 00 – ACOUSTICAL WALL PANELS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.1 SUMMARY

A. This section includes the following:

1. Acoustical Wall Panel

1.2 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for acoustical wall panels, including plans, elevations, sections, details and attachment to other work.

B. Submittals: Furnish 12" x 12" samples, showing manufacture full range of colors, texture and patterns available for each type of acoustical product specified.

C. Product Test Report: From a qualified testing agency indicating wall panels comply with requirements.

D. Qualification Data: For firms specified in "Quality Assurance" Article to demonstrate their capabilities and experience.

E. Product Certificates: Signed by manufacturer certifying that the products furnished comply with requirements.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualification: Manufacture shall have a minimum of 5 years experience in production of specified products and shall furnish supporting documentation showing completed jobs of approximately the same size and scope.

B. Fire Test Reports: Provide acoustical wall panels with the following surface- burning characteristics as per ASTM E 84.

1. Flame Spread: 25 or less
2. Smoke Developed: 450 or less

C. Acoustical Test Report: Provide acoustical test report from a qualified testing agency indicating acoustical wall panels meets 1.15 NRC per ASTM C-423.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect Acoustical Wall Panels from excessive moisture when shipping, storing, and handling. Deliver in unopened skids and store in a dry place with adequate air circulation. Do not delivery material until all wet-work has been completed.

PART 2 – PRODUCTS

2.1 WALL PANELS, GENERAL (AWP)

A. Acoustical Wall Panels shall be 2” thick – 6.0-7.0 lb. per cubic foot high-density fine fibered fiberglass. Manufactures standard panel construction, fully wrapped hardened, panel manufactures standard full line of fabric.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Standard and High-Impact Acoustic Panels
   a. Decoustics, Getzville, NY 716-692-6332
   b. G&S Acoustics, St. Louis, MO 636-225-8800
   c. Kinetics Noise Control, Inc., Dublin OH 877-457-2695
   d. RPG Acoustical Systems, Inc., Passaic, NJ 973-916-1166

C. AWP-1, AWP-2 & AWP-3: 2” FIBERGLASS ACOUSTIC WALL PANEL

1. Collection: See finish legend for acoustically transparent fabric.
2. Color: WALL PANEL FABRIC for color fabric.
3. Size: See plans and elevations.
4. Edge: Square outer assembled perimeter. Square for interior adjoining edges.
5. Installation: 2” thick fabric-wrapped high-impact panel.
6. Location: Lobby.

2.2 WALL PANEL FABRICS

Reference the drawings for FB-# to the AWP-#.

A. AWP-1 to have FB-1 ACOUSTICALLY TRANSPARENT FABRIC
   Manufacturer: Designtex
   Pattern: Everywhere Texture
   Color: Puddle 4147-403
   Location: Lobby

B. AWP-1 to have FB-2 ACOUSTICALLY TRANSPARENT FABRIC
   Manufacturer: Designtex
   Pattern: Everywhere Texture
   Color: Uniform 4147-407
   Location: Lobby

C. AWP-1 to have FB-3 ACOUSTICALLY TRANSPARENT FABRIC
   Manufacturer: Designtex
   Pattern: Everywhere Texture
   Color: Chartreuse 4147-506
   Location: Lobby

D. AWP-1 to have FB-4 ACOUSTICALLY TRANSPARENT FABRIC

Manufacturer:	Designtex
Pattern:	Gamut
Color:	Custom Digitally Printed on DT02 Owner to provide artwork with manufacture to prepare file for printing at scale.
Location:	Lobby

2.3 CONSTRUCTION

A. The acoustical wall panel product shall be supplied in 48” wide panels with up to 120” length. All edges will be fully wrapped with mounting as indicated. For panels that are larger in size, are to panelized with equally spaced vertical and horizontal seams.

2.4 MOUNTING

A. Back-Mounting Accessories: Manufactures standard accessories for securely mounting panels, of type and size indicated and complying with the following requirements:

1. Mechanically Mounted Edge-Reinforced Panels: Metal clips designed to support weight of panels, mechanically attached to wall substrate according to manufactures standard pattern and adhesively bonded to back of panel, with base support brackets where recommended by manufacture for additional support of panels.

2.4 ACOUSTICAL PERFORMANCE

A. Acoustic performance for acoustic panels shall comply with the minimum noise reduction coefficient (NRC) ratings per ASTM C-423 “A” mounting:

1. AWP-1 – NRC 0.95

2.5 FLAMMABILITY RATING

A. All components shall have a Class A Flammability rating per ASTM E- 84: Surface Burning Characteristics of Building Materials, with a Flame Spread of 25 or less and Smoke Developed of 450 or less

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install Acoustical Wall panels in locations indicated, top edges level and in alignment with other panels. Comply with manufactures written instructions for installation of panels using type of mounting accessories indicated or, if not indicated, as recommended by manufacture.

3.2 CLEANING

A. After completion of installation of panels, remove dust and other foreign material according to manufactures written instructions.

B. Remove surplus material, rubbish, and debris resulting from panel installation, on completion of the work, and leave areas of installation in a neat and clean condition.

END OF SECTION 09 84 00

SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.

1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

D. Related Sections include the following:

1. Division 5 Section "Metal Fabrications" for shop priming ferrous metal.
2. Division 8 Section "Steel Doors and Frames" for factory priming steel doors and frames.
3. Division 9 Section "Gypsum Board Assemblies" for surface preparation of gypsum board.
4. Division 23 HVAC.
5. Division 22 Plumbing.
6. Division 26 Electrical.

1.3 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.

4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.4 SUBMITTALS

A. Product Data: For each paint system indicated. Include block fillers and primers.

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

B. LEED Submittals:

1. Comply with Section 01 81 13
   a. MR Credit 2: BPDO – Environmental Product Declarations (EPD): For each product.
   b. MR Credit 4: BPDO – Material Ingredient Reports and/or Material Ingredient Optimization Reports and Action Plans.
      1) Health Product Declaration (HPD): For each product.

C. Samples for Initial Selection: For each type of finish-coat material indicated.

1. After color selection, Architect will furnish color chips for surfaces to be coated.

D. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.

1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.

E. Qualification Data: For Applicator.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.

1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.

    a. Wall Surfaces: Provide samples on at least 100 sq. ft.
    b. Small Areas and Items: Architect will designate items or areas required.

2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.

    a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.

3. Final approval of colors will be from benchmark samples.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep the storage area neat and orderly. Remove oily rags and waste daily.

1.7 PROJECT CONDITIONS

A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.

B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.

C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

1. Benjamin Moore & Co. (Benjamin Moore)
2. M. A. Bruder & Sons, Inc. (M. A. B. Paint).
3. PPG Industries, Inc. (Pittsburgh Paints).
4. Sherwin-Williams Co. (Sherwin-Williams), basis-of-design products and colors.

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying the manufacturer’s product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: As selected by Architect from manufacturer's full range.

1. Anticipate up to 4 exterior colors and 22 interior colors for conventional paint products (refer to Finish Schedule). Ceilings to be flat finish, walls to be eggshell finish, and trim to be semi-gloss finish.

D. Paints and coatings wet-applied within building interior: Comply with the following VOC content limits as expressed in grams per Liter, less water and exempt compounds, of California Air Resources Board (CARB) 2007, Suggested Control Measures (SCM) for Architectural Coatings, or SCAQMD Rule #1113 “Architectural Coatings,” February 5, 2016.
1. Flat Paint or Coating: 50
2. Non-flat Paint or Coating: 50
3. Non-flat – High Gloss Coating: 150
4. Concrete Curing Compound: 100
5. Concrete/Masonry Sealers: 100
6. Dry-fog Coatings: 50
7. Fire-Proofing Coatings: 150
8. Floor Coatings: 50
9. Form Release Compounds: 100
10. Graphic Arts (sign) Coatings: 200
11. High Temperature IM Coatings: 420
12. Industrial Maintenance (IM) Coatings: 100
13. Low-Solids Coating: 120
14. Mastic Coatings: 100

15. Metallic Pigmented Coatings: 150
16. Multi-color Coatings: 250
17. Pretreatment Wash Primers: 420
18. Primers, Sealers and Undercoaters: 100
19. Reactive Penetrating Sealers: 350
20. Recycled Coatings: 250
21. Rust Preventative Coatings: 100
22. Shellac, Clear: 730
23. Shellac, Opaque: 550
24. Specialty Primers, Sealers, and Undercoaters: 100
25. Stains, Interior: 250
26. Stone Consolidants: 450
27. Traffic Coatings: 100
28. Waterproofing Sealer: 100
29. Waterproofing Concrete, Masonry Sealers: 100
30. Wood Coatings: 275
31. Wood Finishes, Varnish: 100
32. Wood Finishes, Sanding Sealer: 275
33. Wood Finishes, Lacquer: 275
34. Wood Preservatives: 350
35. Zinc-Rich Primers: 340

2.3 CONCRETE UNIT MASONRY BLOCK FILLERS

A. Concrete Unit Masonry Block Filler: Factory-formulated high-performance latex block fillers.

1. Sherwin-Williams; LEED Compliant - Interior/Exterior Block Filler B25W25: Applied at a dry film thickness of not less than 8.0 mils., Basis of Design.

2.4 EXTERIOR PRIMERS

A. Exterior Wood Doors, Windows, Ceilings & Trim: Factory-formulated wood primer for exterior application.

1. Sherwin-Williams; Exterior Latex Wood Primer B42W8041: Applied at a dry film thickness of not less than 3.0 mils., Basis of Design.

B. Exterior Hard Wood Surfaces: Factory-formulated oil-based wood primer for exterior application.

1. Sherwin-Williams; Exterior Oil Based Wood Primer Y24W8020: Applied at a dry film thickness of not less than 3.0 mils., Basis of Design.

C. Exterior Ferrous-Metal Primer: Factory-formulated rust-inhibitive metal primer for exterior application.
1. Sherwin-Williams; LEED Compliant – Pro Industrial Pro-Cryl Universal Metal Primer B66-310: Applied at a dry film thickness of not less than 3.0 mils., Basis of Design.

D. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.

1. Sherwin-Williams; LEED Compliant - Pro Industrial Pro-Cryl Universal Metal Primer B66-310: Applied at a dry film thickness of not less than 3.0 mils., Basis of Design.

2.5 INTERIOR PRIMERS

A. New Wood: Factory-formulated latex-based primer for interior application.

1. Sherwin-Williams; Premium Wall/Wood B28W8111. Applied at a dry film thickness of not less than 3.0 mils., Basis of Design.

B. Old Wood: Factory-formulated latex-based primer for interior application.

1. Sherwin-Williams; Adhesion Primer B51W8050. Applied at a dry film thickness of not less than 3.0 mils., Basis of Design.

C. Plaster: Factory-formulated latex-based primer for interior application.

1. Sherwin-Williams; Adhesion Primer B51W8050. Applied at a dry film thickness of not less than 3.0 mils., Basis of Design.

D. Existing Plaster: Factory-formulated latex-based primer for interior application.

1. Sherwin-Williams; Loxon Concrete/Masonry A24W8300. Applied at a dry film thickness of not less than 3.0 mils., Basis of Design.

E. Interior Concrete and Masonry Primer: Factory-formulated alkali-resistant acrylic-latex interior primer for interior application.

1. Sherwin-Williams; LEED Compliant – Loxon Concrete & Masonry Primer B28W8300: Applied at a dry film thickness of not less than 3.0 mils., Basis of Design.

F. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.

1. Sherwin-Williams; LEED Compliant - Promar 200 Zero VOC Latex Wall Primer B28W600 Series: Applied at a dry film thickness of not less than 1.1 mils., Basis of Design.

G. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer.

1. Sherwin-Williams; LEED Compliant - Pro Industrial Pro-Cryl Universal Metal Primer B66-310: Applied at a dry film thickness of not less than 3.0 mils., Basis of Design.

2.6 EXTERIOR FINISH COATS

A. Exterior Wood Doors, Windows, Ceilings & Trim: Factory-formulated satin waterborne latex for exterior application.

1. Sherwin-Williams; Exterior Super Paint A89 Series: Applied at a dry film thickness of not less than 2.5-4.0 mils., Basis of Design.

B. Exterior Semigloss Acrylic Enamel: Factory-formulated semigloss waterborne acrylic-latex enamel for exterior application.

1. Sherwin-Williams; LEED Compliant - Pro Industrial 0 VOC Acrylic Semi-Gloss Coating, B66-650 Series: Applied at a dry film thickness of not less than 2.5-4.0 mils., Basis of Design.

2.7 INTERIOR FINISH COATS

A. Old & New Wood: Factory-formulated eggshell acrylic-latex interior enamel.

1. Sherwin-Williams; LEED Compliant - Promar 200 Zero VOC Interior Latex Eg-Shel, B20Series: Applied at a dry film thickness of not less than 1.7 mils., Basis of Design.

B. Old & New Plaster: Factory-formulated eggshell acrylic-latex interior enamel.

1. Sherwin-Williams; LEED Compliant - Promar 200 Zero VOC Interior Latex Eg-Shel, B20Series: Applied at a dry film thickness of not less than 1.7 mils., Basis of Design.

C. New Interior Gypsum Board Ceiling: Factory-formulated latex-based flat finish for interior application.

1. Sherwin-Williams; LEED Compliant - Promar 200 Zero VOC Interior Latex Flat, B30Series: Applied at a dry film thickness of not less than 1.7 mils., Basis of Design.

D. New & Old Painted Wood Floors: Factory-formulated finish for interior application.

1. Sherwin-Williams; LEED Compliant – Armorseal Tread Plex B90 Series: Applied at a dry film thickness of not less than 1.7 mils., Basis of Design.

E. Interior Low-Luster Acrylic Enamel: Factory-formulated eggshell acrylic-latex interior enamel.

1. Sherwin-Williams; LEED Compliant - Promar 200 Zero VOC Interior Latex Eg-Shel, B20W650 Series: Applied at a dry film thickness of not less than 1.7 mils., Basis of Design.

F. Interior Low-Luster Acrylic Enamel for Wet room areas and areas subject to Heavy Abrasion and Frequent Cleanings, including restrooms: Factory-formulated eggshell waterbased epoxy.

1. Sherwin-Williams; LEED Compliant - Industrial Pre-Catalyzed Waterbased Epoxy Eg-Shel, K45W151 Series: Applied at a dry film thickness of not less than 1.5 mils., Basis of Design.

G. Interior Semigloss Acrylic Enamel: Factory-formulated semigloss acrylic-latex enamel for interior application.

1. Sherwin-Williams; LEED Compliant - Promar 200 Zero VOC Interior Latex Semi-Gloss, B31W650 Series: Applied at a dry film thickness of not less than 1.5 mils., Basis of Design.

H. Interior Semigloss Acrylic Enamel for Ferrous & Galvanized Metal: Factory-formulated semigloss acrylic-latex enamel for interior application.

1. Sherwin-Williams; LEED Compliant - Pro Industrial 0 VOC Acrylic Semi-Gloss Coating, B66-650 Series: Applied at a dry film thickness of not less than 2.5-4.0 mils., Basis of Design.

2.8 INTERIOR WOOD STAINS AND VARNISHES

A. Open-Grain Wood Filler: Factory-formulated paste wood filler applied at spreading rate recommended by manufacturer.

1. Sherwin-Williams; Sher-Wood Fast-Dry Filler., Basis of Design.

B. Clear Sanding Sealer: Factory-formulated fast-drying alkyd-based clear wood sealer applied at spreading rate recommended by manufacturer.

1. Sherwin-Williams; Wood Classics Fast Dry Sanding Sealer B26V43, Basis of Design.

C. Stain: Factory-formulated stain applied at spreading rate recommended by manufacturer.

1. Sherwin-Williams; Wood Classics 250 VOC Satin, Basis of Design.

D. Finish: Factory-formulated finish applied at spreading rate recommended by manufacturer.

1. Sherwin-Williams; Wood Classics WB Poly A68F90 Satin, Basis of Design.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.

1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or another etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.

3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
c. If transparent finish is required, backprime with spar varnish.
d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.

a. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
2. Provide finished coats that are compatible with primers used.
3. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
4. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
5. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
6. Paint the back sides of access panels and removable or hinged covers to match exposed surfaces.
7. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
8. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
9. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as

recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.

2. Omit primer over metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by the manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Mechanical items to be painted are specified to be painted in Division 15.

F. Electrical items to be painted are specified to be painted in Division 16.

G. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

H. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

I. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

J. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

1. Provide satin finish for final coats.

K. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the Project site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.5 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

1. After the work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 EXTERIOR PAINT SCHEDULE

A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.

1. Semigloss Acrylic-Enamel Finish: Two finish coats over a rust-inhibitive primer.

a. Primer: Exterior ferrous-metal primer.
b. Finish Coats: Exterior semigloss acrylic enamel.

B. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:

1. Semigloss Acrylic-Enamel Finish: Two finish coats over a galvanized metal primer.

a. Primer: Exterior galvanizad metal primer.
b. Finish Coats: Exterior semigloss acrylic enamel.

3.7 INTERIOR PAINT SCHEDULE

A. Concrete Unit Masonry: Provide the following finish systems over interior concrete masonry:

1. Low-Luster Acrylic-Enamel Finish: Two finish coats over a block filler.

a. Block Filler: Concrete unit masonry block filler.
b. Finish Coats: Interior low-luster acrylic enamel.

B. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:

1. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.

a. Primer: Interior gypsum board primer.
b. Finish Coats: Interior low-luster acrylic enamel.

C. Wood and Hardboard: Provide the following paint finish systems over new interior wood surfaces:

1. Semigloss Acrylic-Enamel Finish: Two finish coats over a wood undercoater.

a. Primer: Interior wood primer for acrylic-enamel and semigloss alkyd-enamel finishes.
b. Finish Coats: Interior semigloss acrylic enamel.

D. Ferrous Metal: Provide the following finish systems over ferrous metal:

1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.

a. Primer: Interior ferrous-metal primer.
b. Finish Coats: Interior semigloss acrylic enamel.

E. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:

1. Flat Acrylic Finish: Two finish coats over a primer.

a. Primer: Interior zinc-coated metal primer.
b. Finish Coats: Interior flat acrylic paint.

2. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.

a. Primer: Interior zinc-coated metal primer.
b. Finish Coats: Interior semigloss acrylic enamel.

F. All-Service Jacket over Insulation: Provide the following finish system on cotton or canvas insulation covering:

1. Flat Acrylic Finish: Two finish coats. Add fungicidal agent to render fabric mildew proof.

a. Finish Coats: Interior flat latex-emulsion size.

3.8 PAINT SCHEDULE

PT-1
Manufacturer: Sherwin Williams
Color: SW 6070
Name: Heron Plume
Sheen:
Location: General Wall Paint

PT-2
Manufacturer: Sherwin Williams
Color: SW 6257
Name: Gibraltar
Sheen:
Location: Trim Paint

PT-3
Manufacturer: Sherwin Williams
Color: SW 6388
Name: Golden Fleece
Sheen:
Location: Accent Paint

PT-4
Manufacturer: Sherwin Williams
Color: SW 0020
Name: Peacock Plume
Sheen:
Location: Accent Paint

PT-5
Manufacturer: Sherwin Williams
Color: SW 6517
Name: Regatta
Sheen:
Location: Accent Paint

PT-6
Manufacturer: Sherwin Williams
Color: SW 6348
Name: Reynard
Sheen:
Location: Accent Paint

PT-7
Manufacturer: Sherwin Williams
Color: SW 9151
Name: Daphne
Sheen:
Location: Accent Paint

PT-8
Manufacturer: Sherwin Williams
Color: SW 7757

Name:	High Reflective White
Sheen:	Matte
Location:	Exterior Coverboard finish coat for backup to Translucent Wall Panel.

END OF SECTION 09 91 00

SECTION 10 10 00 – VISUAL DISPLAY BOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

. This Section includes the following:

1. Porcelain enamel marker boards.
2. Natural Cork Tack Boards.

A. Related Sections include the following:

1. See Section 06100 Rough Carpentry for wood blocking and grounds.

1.3 SUBMITTALS

A. Product Data: For each type of visual display board indicated. Include motor capacities and individual panel weights for markerboard units.

B. Shop Drawings: For each type of visual display board required.

1. Include dimensioned elevations. Show location of joints between individual panels where unit dimensions exceed maximum panel length.
2. Include sections of typical trim members.
3. Show anchors, grounds, reinforcement, accessories, layout, and installation details.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors and textures available for the following:

1. Markerboards: Actual sections of porcelain enamel finish for each type of chalkboard and markerboard required.
2. Tackboards- Corner sections of frame.

D. Samples for Verification: Of the following products, showing color and texture or finish selected. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected. Prepare Samples from the same material to be used for the Work.

1. Visual Display Boards: Sample panels not less than 8-1/2 by 11 inches (215 by 280 mm), mounted on the substrate indicated for the final Work. Include a panel for each type, color, and texture required.

E. Product Certificates: Signed by manufacturers of tackboards certifying that vinyl-fabric-faced cork tackboard materials furnished comply with requirements specified for flame-spread ratings.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who is an authorized representative of the chalkboard manufacturer for both installation and maintenance of the type of sliding chalkboard units required for this Project.

B. Source Limitations: Obtain visual display boards through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of visual display boards and are based on the products indicated.

D. Fire-Test-Response Characteristics: Provide vinyl-fabric-faced tackboards with the following surface-burning characteristics as determined by testing assembled materials composed of facings and backings identical to those required in this Section per ASTM E 84 by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify vinyl-fabric-faced tackboards with appropriate markings of applicable testing and inspecting agency.

1. Flame Spread: 25 or less.
2. Smoke Developed: 10 or less.

E. Mockups: Before installing visual display boards, construct mockups for each form of construction and finish required to verify selections made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work.

1. Locate mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Notify Architect 7 days in advance of the dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's approval of mockups before proceeding with fabrication of visual display boards.

5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

    a. When directed, demolish, and remove mockups from Project site.
    b. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify field measurements before preparation of Shop Drawings and before fabrication to ensure proper fitting. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.
2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating chalkboards without field measurements. Coordinate wall construction to ensure actual dimensions correspond to established dimensions.

1.6 WARRANTY

A Porcelain Enamel Markerboard Warranty: Submit a written warranty executed by manufacturer agreeing to replace porcelain enamel chalkboards that do not retain their original writing and erasing qualities, become slick and shiny, or exhibit crazing, cracking, or flaking within the specified warranty period, provided the manufacturer's written instructions for handling, installation, protection, and maintenance have been followed.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Porcelain Enamel Markerboards:

    Representative Product Manufacturer:

    a. Claridge Model LCS-II, Series 3 frame and markertray
        1) Color/Finish: No. 75 Low Gloss White.
        2) Magnetic.

3) Size: As shown on the drawings.
4) Marker tray.

Equal Product Manufacturer:

b. ADP/Lemco, Inc.
c. Best-Rite Manufacturing.
d. Egan Visual Inc.

1. Natural Cork Tack Board:

Representative Product Manufacturer:

a. Claridge 800 Series in aluminum frame and Natural-Cork Tackboard 1/4-inch- (6-mm-) thick, natural cork sheet factory laminated to 1/4-inch- (6-mm-) thick hardboard backing.

1) Color/Finish: From manufacturer’s full range of colors.
2) Size: As shown on the drawings.

Equal Product Manufacturer:

b. ADP/Lemco, Inc.
c. Best-Rite Manufacturing.
d. Egan Visual Inc.

2.2 MATERIALS

A. Markerboards:
Porcelain-Enamel Face Sheet: ASTM A 424, enameling-grade steel, uncoated thickness indicated; with exposed face and edges coated with primer, 1.7-to-2.5-mil- (0.043-to-0.064-mm-) thick ground coat, and color cover coat; and concealed face coated with primer and 1.7-to-2.5-mil- (0.043-to-0.064-mm-) thick ground coat.

1. Gloss-Finish Cover Coat: Gloss as indicated; dry-erase markers wipe clean with dry cloth or
standard eraser. Minimum 3.0-to-4.0-mil- (0.076-to-0.102-mm-) thick cover coat. Cover and ground coats shall be fused to steel at manufacturer's standard firing temperatures but not less than 1475 deg F (802 deg C).

a. Color: Low Gloss White: Low glare and distortion free surface allows Use as a projection screen.
b. Locations:
a. Community Room 48”H x96”w
b. Roll Call Room 48”H x96”w
c. Conference Rooms (2) 48”H x72”w

d. Each Shift Leaders Room (3) 48” x 48”
e. Each Office Suite Open Area (5)) 48” x 48”
f. Report Writing Rm 48” x 48”
g. Front Desk Rm 48” x 48”

B. Tack Boards:
1. Natural Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish WITH Class A surface-burning characteristics.
2. Locations:
1. SEE DRAWINGS

C. Linoleum Tack Boards frameless: SEE 09 72 60 TACKABLE WALL COVERINGS

2.3 MARKERBOARD ACCESSORIES

A. Trim and Accessories:

1. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.

2. Markertrays:
a. Manufacturer's standard, continuous, aluminum, Markertray.

2.4 FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
B. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
C. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medicum matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine wall surfaces, with Installer present, for compliance with requirements and other conditions affecting installation of visual display boards.

1. Surfaces to receive markerboards shall be free of dirt, scaling paint, and projections

or depressions that would affect smooth, finished surfaces of chalkboards or markerboards.

2. Surfaces to receive tackboards shall be dry and free of substances that would impair the bond between tackboards and substrate.
3. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF MARKERBOARDS

A. Deliver factory-built visual display boards completely assembled in one piece without joints, where possible. If dimensions exceed panel size, provide 2 or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints to maintain surface alignment.

B. Install units in locations and at mounting heights indicated and according to manufacturer's written instructions. Keep perimeter lines straight, plumb, and level. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

C. Coordinate Project-site-assembled units with grounds, trim, and accessories. Join parts with a neat, precision fit.

3.3 ADJUSTING AND CLEANING

A. Verify that accessories required for each unit have been properly installed and that operating unit’s function properly.

B. Clean units according to manufacturer's written instructions.

END OF SECTION 10 10 00

SECTION 10 14 00 - SIGNAGE

PART 1 - GENERAL

1.1 STIPULATIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior panel signs.
2. Dimensional characters (letters and numbers) for exterior use including backlit and unlit.
3. Signage accessories.

B. Related Sections include the following:

1. Division 23 Section "Mechanical Identification" for labels, tags, and nameplates for mechanical equipment.
2. Division 26 Section "Electrical Identification" for labels, tags, and nameplates for electrical equipment.
3. Division 26 Section "Lighting" for illuminated exit signs.
4. 03 45 00 PRECAST ARCHITECTURAL CONCRETE for recessed signage.

1.3 SUBMITTALS

A. Product Data: profiles and construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.

B. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.

1. Provide message list for each sign, including large-scale details of wording, lettering, artwork, and braille layout.

C. Samples for Initial Selection: For each type of sign material indicated that involves color selection.

D. Samples for Verification: For each type of sign, include the following Samples to verify color selected:

1. Panel Signs: Full-size Samples of each type of sign required.

E. Qualification Data: For Installer.

F. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of the signage manufacturer for installation and maintenance of units required for this Project.

B. Source Limitations: Obtain each sign type through one source from a single manufacturer.

C. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.

1. Interior Code Signage: Provide signage as required by accessibility regulations and requirements of authorities having jurisdiction.

1.5 PROJECT CONDITIONS

A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions by field measurement before fabrication and indicate measurements on Shop Drawings.

1.6 COORDINATION

A. For signs supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Interior Panel Signs, Basis-of-Design Product:
   a. Mohawk Sign System MP 200 A Format or equal. The design for each sign is based on the product type named.
   b. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.
2. Exterior Dimensional Lettering, Basis-of-Design Product:
   a. Gemini

2.2 INTERIOR PANEL SIGNS

A. General: Provide panel signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

1. Produce smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch measured diagonally.

2.

B. Manufacturers:

1. Basis of Design, Mohawk Sign Systems, Inc.
2. Apco Signs
3. ASI Modulex, Architectural Signage Solutions
4. Best Sign Systems. Inc.
5. InPro Corporation
6. Signature Signs
7. InVision Signs

C. Laminated Sheet Sign. Sandblasted polymer face sheet with raised graphic laminated over subsurface graphics laminated over subsurface graphics to acrylic backing sheet to produce composite. Styles and types shall be as indicated in sketches and shall match Owner's interior signage standard.

D. 'Paper Grabber' at bottom of signs shall be as indicated Type 2 signs in sketches/schedules.

E. 'Finger Hole' access for view panels to allow users to insert and extract paper inserts shall be as indicated in sketches/schedules.

F. Mounting for each sign style and type shall be as indicated in sketches/schedules.

G. Cast-Acrylic Sheet: Manufacturer's standard and as follows:

1. Color: As selected by Architect from manufacturer's full range.
2. 1/16" Horizontal V Groove
3. Thickness:

   a. Static Signs: 1/4" Acrylic
   b. Signs with Acrylic Window: milled edge creating a continuous U-shape frame to engage the acrylic Window.

H. Before specifying, verify availability of plastic-laminate materials in color combinations required.

I. Delete paragraph and subparagraphs below if no unframed panel signs.

J. Perimeter: Fabricate edges to profile indicated; comply with the following requirements for materials and corner conditions:

1. Material: Romark or Equivalent.
2. Corner Condition: sharp corners

K. Graphic Content and Style: Provide sign copy that complies with requirements indicated in the Sign Schedule for size, style, spacing, content, mounting height and location, material, finishes, and colors of signage.

L. Graphic Symbols:

1. Owner Provided Graphic for raised pattern header. EPS file available upon request after bidding phase. See Interior Signage drawings.

2. Color: As selected by Architect from Manufacturer's full range

M. Acrylic Sheet Plastic Window: Plexiglass II by Rohm & Hass Co. or equal.

N. Text Fonts: Sans Serif: Gill Sans, ¾ » high

O. Blank Aluminum Sign Panels: To be used as a backer for mounting signs on window areas other than sidelights. At Doors with sidelights, sidelights are considered to be part of the door; sign to be mounted beside sidelight.

P. Tactile and Braille Copy: Manufacturer's standard process for producing copy complying with ADA Accessibility Guidelines and ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square cut edges free from burrs and cut marks.

1. Panel Material: Opaque acrylic sheet
2. Ball Pointed Braille.
3. Raised-Copy Thickness: Not less than 1/32 inch.

Q. Accessories:

1. Mounting Methods: Use concealed fasteners or double-sided vinyl tape fabricated from materials that are not corrosive to sign material and mounting surface.

R. Adhesives: VOC Content of 70 g/L or less.
1. For adhesives, indicating compliance with requirements for low-emitting materials.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

S. Copy & Schedule:
1. If there are any inconsistencies between the drawings and schedule
2. Room names shall be changed through the shop drawings. Room number is for drawings and installation scheduling purpose and may not be included in the room signage or be changed.
3. Provide Microsoft excel formatted spreadsheet, organized based on the signage schedule and modified per the mfg. means and methods for their production. This document is to be used to finalize copy with the user group in submittal process.

2.3 INTERIOR PANEL SIGN TYPES (Types are as designated on the Drawings)

A. Type 1: GENERAL ROOM SIGN
1. Provide two signs per location indicated in the plan
2. Custom Raised Header
3. Text: As indicated in the Sign Schedule.
4. Message: Fixed.
5. Size: 6" x 6"
6. Mounting: Wall.

B. Type 2: INTERIOR PRIVATE OFFICE SIGN with Clear Acrylic Insert Window w/ finger hole and paper grabber.

1. Provide two signs per location indicated in the plan
2. Custom Raised Header : ROOM NAME (no number).
3. Text: As indicated in the Sign Schedule. Provide laser printed inserts on cardstock.
4. Message: Changeable.
5. Accessory: Satin Silver color paper display gripper 8.5” long.
6. Size: 8.5” x 8.5”
7. Mounting: Wall.

C. Type 3 EGRESS STAIR SIGN –
1. Custom Raised Header
2. Text: As indicated in the Sign Schedule.
3. Message: Fixed.
4. Size: 9.75” x 8.5”
5. Mounting: Wall.
6. Stair Symbol, human figure and fire symbols

D. Type 4, ELEVATOR SIGN (IN CASE OF FIRE…) Elevator Signs in accordance with NFPA
1. Custom Raised Header
2. Text: As indicated in the Sign Schedule.
3. Message: Fixed.
4. Size: 9.75” x 6.75”
5. Mounting: Wall.
6. Universal Pictogram Symbol and Instructional Text.

E. Type 5, EVACUATION PLAN SIGN

1. Text: As indicated in the Sign Schedule.
2. Message: Fixed.
3. Size: 12” x 12”
4. Acrylic Insert Slot, Arch. to provide plan.
5. Mounting: Wall.

F. Type 6, WAYFINDING BLADE SIGN (wall blade or ceiling blade)

1. Custom Raised Header
2. Text: As indicated in the Sign Schedule.
3. Message: Fixed.
4. Size: 9.75” x 6.75”
5. Mounting: Wall.
6. Universal Pictogram Symbol for restrooms
7. Size: 12” x 16” wide.
8. Mounting: Wall.
9. Locate under lobby bulkhead near entry to the public restroom

G. Type 7A, NO SMOKING SIGN

1. Universal Pictogram Symbol and Instructional Text.
2. Size: 9.75” x 8.5”
3. Mounting: Wall.

4. Copy: No Smoking within 25 feet of building entrance

H. Type 7B, NO SMOKING SIGN – GLASS DECAL

1. Universal Pictogram Symbol and Instructional Text.
2. Size: 9.75” x 8.5”
3. Mounting: Wall.
4. Copy: No Smoking within 25 feet of building entrance

I. Type 8A: ADA STAFF RESTROOM SIGNS

1. Universal Pictogram Symbol and Instructional Text.
2. Size: 9.75” x 8.5”
3. Mounting: Wall.
4. Pictogram to include Men / Women and ADA
5. COPY: ADA RESTROOM

J. Type 8B: ADA RESTROOM w/ BABY CHANGING ROOM SIGN

1. Universal Pictogram Symbol and Instructional Text.
2. Size: 9.75” x 8.5”
3. Mounting: Wall.
4. Pictogram to include BABY CHANGING STATION
5. Copy: UNISEX RESTROOM WITH BABY CHANGING STATION

K. Type 8C: ADULT CHANGING ROOM SIGN

1. Universal Pictogram Symbol and Instructional Text.
2. Size: 9.75” x 8.5”
3. Mounting: Wall.
4. Pictogram to include Men / Women and ADA
5. Copy: : UNISEX RESTROOM WITH ADULT CHANGING STATION

L. Type 9A, METAL LOCKER DECAL (PROVIDE WITH ADD ALTERNATE #3)
1. Provide 2 (duplicate) for each indicated in plan
2. Custom printed vinyl sticker
3. Size: 4”x5”
4. Copy: LOCKER POWER OUTLETS DO NOT SUPPORT HAIR DRYERS
5. LOCATION: One per every island, bank or row of lockers in the locker rooms only.

M. Type 9B, ADA METAL LOCKER DECAL
1. Provide 1 for each indicated in plan
2. Custom printed vinyl sticker
3. Size: 4”x5”
4. Copy: ADA LOCKER (ADA ICON)
5. LOCATION: One per designated ADA lockers in the locker rooms only.

N. Type 10, LEED INNOVATION SIGNAGE

1. Artwork: Architect to provide artwork and copy with submittal
2. Material: Typical Romark with direct print.
3. Color: Architect to select stock Romark color
4. Size: 16”x20”
5. Mounting: Wall.
6. QTY: 12

O. Type 11A, LEED STAIR WELLNESS SIGNAGE

1. Artwork: Architect to provide artwork and copy with submittal
2. Material: Typical Romark with direct print.
3. Color: Architect to select stock Romark color
4. Size: 8”x10”
5. Mounting: Wall.
6. QTY: 4

P. Type 11B Mounted frameless glassless photographs
1. ARTWORK: Provided by owner after submittal, proof will be required in separate submittal.
2. Provide 1 full size sample for owner approval
3. Printing: Direct color and black and white printed image on aluminum dibond (or equal substrate).
4. Edge, Back bevel edges
5. Mounting: Aluminum cleat mounting kit
6. Size: 16”x20”
7. QTY: 30

Q. Type 11C Mounted frameless photograph with floating tempered glass on brass 1” standoff mounts
1. ARTWORK: Provided by owner after submittal, proof will be required in separate submittal.
2. Provide 1 full resolution 16x16 size sample print for owner approval.
3. Printing: Direct color and black and white printed image on aluminum dibond (or equal substrate).
4. Edge, Back bevel edges
5. Mounting: Aluminum cleat mounting kit
6. Size: See elevation in community room above casework
7. QTY: 1
8. Location: Community room over sink.

R. Type, 12 Electrical Room Panel Signs

1. Universal Pictogram Symbol and Instructional Text.
2. Mounting: Wall.

S. Type 13, Fire Extinguisher Panel Signs

1. Universal Pictogram Symbol and Instructional Text.
2. Mounting: Wall.

T. Type 14, Danger Electrical Room
1. Provide two signs (duplicates) per locations indicated in the plan.
2. Danger Sign direct print to white romark.
3. Mounting: Door.

U. Type 15, Roof Access Panel Signs -

1. Universal Pictogram Symbol and Instructional Text.
2. Mounting: Wall.

V. Type 20, Restricted Area Sign-
1. ARTWORK: Provided by owner after submittal, pdf. file available.
2. Printing: Direct color and black and white printed image on approx. 3mm aluminum thick.
3. Edge, ease edges round corner.
4. Mounting: bolted at corners to masonry wall for exterior and used typical adhesive for interior
5. Size: 12”x18”
6. Text to read: Restricted Area Authorized Employees Only
7. QTY: 13
8. Location: SEE PLAN. AT EACH ENTRANCE TO THE BUILDING, PUBLIC AND PRIVATE.

2.4 DIMENSIONAL CHARACTER SIGNS

A. Fabricated Channel Characters: Form exposed faces and sides of characters to produce surfaces free from warp and distortion. Include internal bracing for stability and attachment of mounting accessories. Comply with the following requirements:

1. Aluminum Sheet: Not less than 0.090 inch (2.29 mm) thick.
2. Metal Finishes: Dark Bronze Alloy 5052
3. Standard Thickness 1-1/2” Deep
4. Face Style: Metal Face/ Side Lit L400
5. Mounting: Pin mounted.
6. LED color option: Warm White
7. Finish: Anodized metallic custom color.

B. General: Provide dimensional character signage that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

1. Fabricated Aluminum Channel Letters – Exterior

a. Form exposed faces and sides of characters to produce surfaces free from warp and distortion. Include internal bracing for stability and attachment of mounting accessories.
b. Aluminum Sheet: Not less than 0.090 inch thick

C. Illuminated Backlighted Channel Characters: Manufacturer's standard LED lighting including transformers, insulators, and other components. Make provisions for servicing and concealing connections to building electrical system.

D. Types:

1. Type 16 Exterior Fabricated Metal Pin Lettering w/ Back Lighting – CANOPY ENTRANCE SIGNAGE
   a. Text: As indicated in the drawing 5/A6.40.
   b. Mounting: Through wall penetrations to be coordinated with electrical contractor and signage contractor to seal all penetrations. Pin standoff 1”
   c. Dimensions
      1) Depth: 2”
      2) Height: 18”
   d. Basis of Design: Gemini Dimensional Stainless Steel Halo Lit, fabricated letters or equal
   e. Finish: #4 Brushed Stainless Steel Metal finish. Warm White LED Color – Needs to be coordinated with electrical.
   f. LOCATION: Canopy elevation make call out, dim lettering, tag with type. Indicate with tag in plan outside vest.
   g. COPY: PRECINCT 1 WILKENS POLICE STATION

2. Type 17 Exterior Fabricated Metal Pin Lettering – COMMUNITY MESSAGE BOARD
   a. Text: As indicated in the drawing 5/A6.40.
   b. Mounting: Through wall penetrations to be coordinated with electrical contractor and signage contractor to seal all penetrations. Pin standoff 1”
   c. Dimensions
      1) Depth: 1/4”
      2) Height: 4”
   d. Basis of Design: Gemini Dimensional Stainless Steel , fabricated letters or equal
   e. Finish: Kynar pain system RAL colors to be selected by architect.
   f. LOCATION: Make detail elevation from the vestibule elevation dimension text and elevation from AFF
   g. COPY: PRECINCT 1 WILKENS POLICE STATION

3. Type 18 RECESSED LETTERING CAST INTO PRECAST PANEL – MONUMENTAL SIGNAGE
   a. Text: PRECINCT 1 WILKENS POLICE STATION.
   b. Provided & Coordinated with 03 45 00 PRECAST ARCHITECTURAL CONCRETE and precast installer.
   c. Dimensions
      1) Depth: 1/2” beveled
      2) Height: see elevations
   d. LOCATION: Type 18, Monument sign, is located on 3/L4.03 & indicated as W1 on L1.01"

4. Type 19 RECESSED COUNTY SEAL & LETTERING CAST INTO PRECAST PANEL – CORNERSTONE SIGNAGE

a. Text: BALTIMORE COUNTY SEAL – POLICE DEPARTMENT - 2025.
b. Provided & Coordinated with 03 45 00 PRECAST ARCHITECTURAL CONCRETE and precast installer.
c. Dimensions: see elevations
   1) Depth: 1/2” beveled lettering
   2) Height: see elevations
d. LOCATION: See elevations

E. Manufacturers:
   1. Basis of Design: Gemini Incorporated.
   2. Advance Corporation; Braille-Tac Division.
   3. A. R. K. Ramos.
   4. ASI-Modulex, Inc.
   5. Bunting Graphics, Inc.
   6. Charleston Industries, Inc.
   7. Grimco, Inc.
   8. Innerface Sign Systems, Inc.
   9. Metal Arts; Div. of L&H Mfg. Co.
   10. Mills Manufacturing Company.
   11. Mohawk Sign Systems.
   12. Nelson-Harkins Industries.
   13. Signature Signs, Incorporated.
   14. Southwell Company (The).

2.5 FINISHES, GENERAL

A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

C. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: Manufacturer's standard clear anodic coating, 0.018 mm or thicker, over a satin directionally textured mechanical finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Verify that items provided under other sections of Work are sized and located to accommodate signs.

C. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Locate signs and accessories where indicated, using mounting methods of types described and in compliance with manufacturer's written instructions.

1. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.
2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.

B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using methods indicated below:

1. All room numbers, nameplates, and room identification signs will be adhered to 1/8” thick finish PVC material (Sintra, Celtec, Komacel, Komatex, or equivalent) with 3M VHB Very High Bond Joining Systems #9473 double-sided tape (or equivalent). All signs to be mounted on block wall shall have the entire perimeter of the sign taped with 3M double sided tape #4432 (or equivalent).

C. Dimensional Characters: Attach individual characters to wall surfaces using methods indicated below:
1. Mount characters using standard fastening methods recommended in writing by manufacturer for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.

3.3 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 10 14 00

SECTION 10 14 53 - SITE SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

C. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition. Alternate methods and/or materials may be submitted to the Architect for consideration. Those judged to be equal to that specified will receive written approval.

1.2 SUMMARY

A. Furnish all labor, materials, equipment and services necessary for and reasonably incidental to complete the site signs work as indicated on drawings or specified, including but not limited to the following:

1. Exterior Parking Signs
2. External Traffic Control Signs

1.3 QUALITY ASSURANCE

A. Uniformity of Manufacturer: For each sign form and graphic image process indicated, furnish products of a single manufacturer.

B. All signage to comply with the latest A.D.A. requirements, and the latest Manual for Uniform Traffic Control Devices (M.U.T.C.D.).

C. In the event of a discrepancy between the Project Specifications, Construction Documents, Baltimore County Standard Specifications and Details, or other guidelines set forth by the authorities having jurisdiction the more stringent will apply.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for each type of sign required.

B. Samples: Submit samples of each sign form and material showing finishes, colors, surface textures and qualities of manufacture and design of each sign component, including graphics.

1. Submit full-size sample units. Acceptable units may be installed as part of the work.

C. Shop Drawings: Submit shop drawings for fabrications and erection of specialty signs. Include plans, elevations and large-scale details of sign wording and lettering layout. Show anchorages and accessory items. Furnish location template drawings for items supported or anchored to permanent construction.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Andco Industries Corp.

B. A.S.I. Sign Systems

C. Spanjer Brothers, Inc.

D. The Supersine Company

E. Southwell Company

2.2 GENERAL REQUIREMENTS

A. All letters shall be Helvetica Medium; upper case.

B. Letters shall be centered on signs.

C. Panel backgrounds shall be colored from manufacturer's standards with matte finish.

2.3 MATERIALS

A. Aluminum Casting: Alloy and temper recommended by aluminum producer or finisher for typed of use and finish indicated and with not less than the strength and durability properties specified in ASTM B 221 for 6063 TS

2.4 EXTERIOR PARKING SIGNS

A. Type: Silk screened letters and symbol on 0.125" dark blue baked enamel color aluminum message panel, supported on 2" square steel post in concrete footing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install sign units and components at locations indicated on the drawings securely mounted with concealed theft resistant fasteners, unless otherwise indicated. Attach signs to substrates in accordance with manufacturer's instructions.

B. Install sign units level, plumb and at proper height. Cooperate with other trades for installation of sign units to finish surfaces. Repair and replace damaged units as directed by Architect.

C. Installation of Exterior Parking Signs:

1. Erect sign plumb with top as indicated on the drawings.
2. Anchor to concrete footing with concealed anchors in accordance with manufacturer's recommendations.

3.2 CLEANING AND PROTECTION

A. At completion of installation, clean soiled sign surface in accordance with manufacturer's instructions. Protect units from damage until acceptance by Owner.

END OF SECTION

SECTION 10 15 50 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes HDPE units as follows:
   1. Toilet Enclosures : HDPE. Floor Mounted, Overhead Braced. Located in the Typical Locker Rooms

   2. Urinal Screens: HDPE. Wall hung Provide for Men’s Locker Room

B. Related Sections include the following:
   1. Division 10 "Toilet and Bath Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

   1. Show locations of cutouts for compartment-mounted toilet accessories.
   2. Show locations of reinforcements for compartment-mounted grab bars.

C. Samples for Initial Selection: For each type of unit indicated.

D. Samples for Verification: Of each type of color and finish required for units, prepared on 6-inch-square Samples of same thickness and material indicated for Work.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable provisions in "Americans with Disabilities Act (ADA) and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating toilet compartments without field measurements. Coordinate wall, floor, ceilings, and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 HIGH-DENSITY POLYETHYLENE PARTITIONS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Scranton Products Hiney Hiders (basis of design) (FKA Santana Products)
2. Accurate Partitions Corporation.
3. Comtec Industries/Capitol Partitions
4. General Partitions Mfg. Corp.
5. Rockville Partitions, Inc.

B. Toilet-Enclosure Style: Floor Mounted/Wall Braced.

C. Urinal-Screen Style: Wall hung.

D. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.

1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
2. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum or stainless-steel strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
3. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range.

E. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; or stainless steel.

F. Brackets (Fittings):
1. Full-Height (Continuous) Type: Manufacturer's standard design; extruded aluminum.

G. Finish: Anti-Graffitti HDPE partitions, Smooth Stainless steel corrosion resistant hardware.

2.2 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.3 FABRICATION

A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

C. Doors: Unless otherwise indicated, provide 24-inch- wide in-swinging doors for standard toilet compartments and 36-inch- wide out-swinging doors with a minimum 32-inch- wide clear opening for compartments indicated to be accessible to people with disabilities.

1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
2. Latch and Keeper: Manufacturer's standard [recessed] [surface-mounted] latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.
3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors[and entrance screen doors].
5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch.
b. Panels and Walls: 1 inch.

2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Secure continuous head rail to each pilaster with not less than two fasteners. Hang doors to align tops of doors with tops of panels and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches (51 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

G. Wall-Hung Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 10 15 50

SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Corner guards.
   2. Kick Plates see door hardware

B. Related Requirements:

   1. Section 05 50 00 "Metal Fabrications" for steel angle corner guards.
   2. Section 08 71 00 "Door Hardware" for kick plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For each type of wall and door protection showing locations and extent.

   1. Include plans, elevations, sections, and attachment details.

C. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated, in each color and texture specified.

   1. Include Samples of accent strips and accessories to verify color selection.

D. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:

   1. Wall Guards: 12 inches (300 mm) long. Include examples of joinery, corners, end caps, and field splices.
   2. Handrails: 12 inches (300 mm) long. Include examples of joinery, corners, and field splices.
   3. Corner and End-Wall Guards: 12 inches (300 mm) long. Include example top caps.
   4. Door-Surface Protection: 6 by 6 inches (150 by 150 mm) square.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of handrail.

B. Material Certificates: For each type of exposed plastic material.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wall-Guard Covers: Full-size plastic covers of maximum length equal to 5% of each type, color, and texture of cover installed.
2. Corner-Guard Covers: Full-size plastic covers of maximum length equal to no fewer than two, 48-inch-long units.
3. Mounting and Accessory Components: Amounts proportional to the quantities of extra materials. Package mounting and accessory components with each extra material.

1.7 QUALITY ASSURANCE

A. Certified Wood: Provide an invoice including vendor's chain-of-custody number, product cost, and entity being invoiced.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored.
2. Keep plastic materials out of direct sunlight.
3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F (21 deg C).

a. Store corner-guard covers in a vertical position.
b. Store wall-guard covers in a horizontal position.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.

B. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design InproCorp :1600 Wall Guards, & 160 High Impact Corner Guard
1. IPC Interior Protection Products and Decorative Surfaces
Inpro Corporation, PO Box 406, Muskego, WI 53150, USA
Telephone: 800.222.5556, Fax: 888.715.8407
www.inprocorp.com

B. Source Limitations: Obtain wall and door-protection products of each type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

2.3 CORNER GUARDS

A. Aluminum Corner Guard: A. Corner Guard System, Basis of Design: 1.5” clear anodized finshed, 90 degrees, 12’ lengths. Standard-duty, adhered to finished wall; designed to withstand impacts
1. Cover: Extruded Aluminum 1.6mm 0.63” thick from 6063-t6 alum. or 5005-H34 alum.

a. Profile: Nominal 1.5-inch- (38-mm-) wings.
b. Height: see drawings
c. Color and Texture: clear anodized 204R1

2. Attachment: Field Applied Adhesive: #535 HEAVY DUTY ADHESIVE
3. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.

2.4 PLASTIC DOOR-PROTECTION PLATE

A. Kick Plate for Door per door hardware sets

2.5 MATERIALS

A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required; thickness as indicated.

B. Polycarbonate Plastic Sheet: ASTM D6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. (800 J/m) of notch when tested according to ASTM D256, Test Method A.

C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

D. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.

E. Adhesive: As recommended by protection product manufacturer.
1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.6 FABRICATION

A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

D. Wood Handrails: Miter corners and ends of wood handrails for returns.

2.7 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Before installation, clean the substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.
1. Wall Guard Rails: T.O. 2’-8” above finished floor.
2. Corner Guard’s: As indicated on drawings and in coordination with Wall Guard & vinyl base by others.
3. Kick Plate: 36” above finished floor per Door Type G1.

C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.

1. Provide anchoring devices and suitable locations to withstand imposed loads.

2. Where splices occur in horizontal runs of more than 20 feet (6.1 m), splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches (305 mm) apart.
3. Adjust end and top caps as required to ensure tight seams.

D. Abuse-Resistant Wall Covering by others: Install top and edge moldings, corners, and divider bars as required for a complete installation. Coordinate with GC installation of the VWC prior to wall guard and corner guard installation.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 10 26 00

SECTION 10 26 41 – BULLET RESISTANT PANELS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes bullet resistant fiberglass panels and batten strips for seams.

1.2 REFERENCES

A. American Society for Testing and Materials:
   1. ASTM E119-98 Standard Test for One-Hour Fire-Rating of Building Construction and Materials
   2. ASTM F1233-98 Standard Test Method for Forced Entry Testing of Materials/Assemblies, Class IV
B. International Organization for Standardization:
   1. ISO 9001:2015 Quality Management System
C. National Institute of Justice Ballistic Standards:
   1. NIJ Standard 0108.01 – Type III-A
D. Small Business Administration:
   1. SBA Small Business Size Standard
E. Underwriters Laboratories:
   1. UL 752 Specifications and Ammunition, 11th Edition, Standard for Bullet Resisting Equipment published September 9, 2005, revised December 21, 2006, Level 3
F. The United States Department of State:
   1. The International Traffic in Arms Regulations (ITAR)

1.3 SUBMITTALS

A. Submittals for Review: Submit for approval prior to fabrication.
   1. Product Data: Include specifications, brochures, and samples.
   2. Recommendations for installation of Bullet Resistant Fiberglass Panels available in print document and video link.
B. Certificates: Submit printed data to indicate compliance with following requirements.
   1. UL LISTING Verification and UL752 Current Test Results as provided by Underwriters Laboratories.
   2. ASTM E119-98 One-Hour Fire Rating of Building Construction and Materials.
   3. ASTM F1233-98 Standard Test Method for Forced Entry Testing of Materials/Assemblies.
   4. Manufacturer’s third party certificate of registration with ISO 9001:2015.
   5. Manufacturer’s U.S. Dept. of State ITAR Statement of Registration.
   6. Manufacturer’s SBA Profile verifying small business status by the SBA.

1.4 DELIVERY, HANDLING, AND STORAGE

A. Deliver materials to project with manufacturer’s UL LISTED Labels intact and legible.
B. Handle material with care to prevent damage. Store materials inside under cover, stack flat and off the floor.

1.5 WARRANTY

A. Warrant all materials and workmanship against defects for a period of ten (10) years from the date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Design Basis: Contract Documents are based on ArmorCore by Waco Composites, (Waco, TX 76710, phone: 254-752-3622, toll free: 866-688-3088, email: sales@armorcore.com, web: www.armorcore.com)

OR Approved equal.

2.2 PERFORMANCE CRITERIA

A. Bullet Resistant Fiberglass Panels shall be “non ricochet type” to permit the encapture and retention of an attacking projectile lessening the potential of a random injury or lateral penetration.
B. Panel Rating: UL752 Level 3.
C. Bullet resistance of joints: equal to that of the panel.

2.3 MATERIALS

A. Panels fabricated of multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets.
B. Thickness: 7/16”, ½” nominal thickness. Coordinate with equal thickness GWB above ballistic panel.
C. Nominal Weight: 4.8 lbs. per sq. ft.
D. Available Panel Sizes: 3’ x 8’
E. Panels manufactured in the United States of America with raw materials sourced from the U.S.A. for quality assurance purposes and to comply with any applicable “Buy American” provisions.
F. Provide for 4” wide batten strip from single source as panel at each horizontal and vertical seam.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to starting installation, verify work of related trades required in contract documents and architectural drawings is complete to the point where work of this Section may properly commence.

3.2 JOINTS

A. Reinforce joints with a back-up layer of bullet resistive material. Minimum width of reinforcing layer at joint shall be 4-inches, centered on panel joints.
B. Finished drywall layer is to be placed offset from ballistic panel.

3.3 APPLICATION

A. Install armor in accordance with manufacturer’s printed recommendations and as required by contract documents.
B. Secure armor panels using screws, bolts, or an industrial adhesive.

1. Method of application shall install panels minimizing vulnerabilities by fitting tightly to adjacent surfaces including concrete floor slab, concrete roof slab, bullet resistive door frames, bullet resistive window frames, and the like.

END OF SECTION 10 26 41

SECTION 10 28 00 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Toilet accessories
2. Underlavatory guards
3. Grab bars
4. Changing Stations
5. Custodial Accessories

B. Related Sections include the following:

1. Division 10 Section "Toilet Compartments" for compartments and screens.
2. Division 08 83 00 Mirrors

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations indicated on Drawings in product schedule.

D. Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

1.4 QUALITY ASSURANCE

A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.

1.5 COORDINATION

A. See TA Sechedule on drawings.

B. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by General Contractor under requirements of the Contract Documents.

B. Manufacturer's Warranty:

1. Minimum Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers Names: Use of manufacturer’s proprietary names to designate products is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers.

1. Toilet Accessories:

a. **CSR** Shower Curtain & Rod with curtain hooks
   a. Opaque Matte White Vinyl (width per location) Basis of Design Bobrick #204-3 or 4 provide curtain hooks #204-1 per location width.
   b. Heavy-duty shower curtain rod, satin finish, Basis of Design Bobrick B6107 Series, per location width.
b. **TD-1** Paper Towel Dispenser: Scotts Essential High Capacity Hard Roll Towel Dispenser, for 8” paper towel roll. #46253. NO SUBSTITUTIONS
c. **WR-1** Waste recepticle Rubbermaid 25 gallon domed trash can with push-top. # H-1197BL. NO SUBSITUTIONS.
d. **SD-1** Soap Dispenser: Gojo item #9034 NO SUBSITUTIONS.
e. **TP-1** Toilet Paper Holder: Jumbo Toilet Paper Dispenser SCA 56TR or Single Jumbo Roll Advantage PFTRD002601. NO SUBSITUTIONS.
f. **EHD** Electric Hand Dryer, Excel-dryer-xlerator 455A30 XL-SB-1.1N-110-120V in Stainless steel. NO SUBSITUTIONS.
g. **TSC-1** Toilet Seat Cover Dispenser: Neat Seat, Half Fold/ White Winco TSC10. NO SUBSITUTIONS.
h. **MIR** Mirrors, see 08 83 00 and interior elevations.
i. **GB-#s** ADA grab bars, (see section 2.4).
j. **SN-1** Sanitary Napkin Disposal Unit: Rubbermaid model 6140 NO SUBSITUTIONS
k. **TH-1** Coat/Garmet Hook – Surface Mounted Coat Hook with Bumper, satin finish, Basis of Design Bobric #B-9541

2. Underlavatory Guards (at gun cleaning sink or any other exposed P-trap):

a. Brocar Products, Inc.
b. Truebro, Inc.
c. Approved equal

3. Grab Bars: (see section 2.4)

a. Minimum 0.05" thick, 1 ½" outside diameter with manufacturer's standard slip-resistant texture. Concealed mountings shall have manufacturer's standard flanges and anchors. Install per ADAAG.
b. **GB-18, GB-36, GB-42**
c. See detention furnishings specifications for anti-ligature grab bars.

4. Changing Stations: (see section 2.3)

a. **ADC-1** Adult Changing Station by Koala Kare, item KB3000-AHL.
   a. NO SUBSITUTIONS
   b. Provide in wall blocking per manufacturer's requirements.

b. **DC-1** Baby Changing Station by Koala Kare, item KB300-SS
   a. NO SUBSITUTIONS

5. Custodial Accessories:

a. **MB-1** Shelf with Mop and Broom Holders and Rag Hooks by Bobrick # B-224 x 36 at each mop sink location. **LOCATIONS JC 131 & 225**

6. ADA Shower Seat:

a. **BN-1** ADA folding shower bench. 32" x 22½" ADA Reversible Shower Seat, Wall Supported, Phenolic Solid TEAK - MODEL: APFSLR-320225PTS by Freedom Showers or equal.

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.

B. Plastic: High-impact ABS grey plastic.

C. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch (0.9-mm) minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.

D. Galvanized Steel Sheet: ASTM A 653/A 653M, G60 (Z180).

E. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.

F. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

G. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed

2.3 DIAPER CHANGING STATION

A. Surface Mounted Baby Changing Station:
1. **DC-1** Diaper-changing station
2. Basis of Design: Koala Kare Model KB200.
3. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
   Engineered to support minimum of 200-lb static load when opened.
4. Mounting: Surface mounted, with unit projecting not more than 4 inches (102 mm) from wall when closed.
5. Operation: By pneumatic shock-absorbing mechanism.
6. Material and Finish: HDPE in manufacturer's standard color gray.
7. Liner Dispenser: Provide built-in dispenser for disposable sanitary liners.

B. Surface Mounted Adult Changing Station:
1. **ADC-1** Diaper-changing station (DC)
2. Basis of Design: Koala Kare Model Koala KB-3000 .
3. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.

   Engineered to support minimum of 350-lb (113-kg) static load when opened.
4. Mounting: Surface mounted, with unit projecting not more than 4 inches (102 mm) from wall when closed. GC to coordinate wall framing and blocking per MFG. details.
5. Operation: By pneumatic shock-absorbing mechanism.
6. Material and Finish: HDPE in manufacturer's standard color gray.
7. Liner Dispenser: Provide built-in dispenser for disposable sanitary liners.

2.4 GRAB BARS (GB-#)

A. Stainless Steel Grab Bars: With snap flange covers:
1. Satin Finish:
   a. Basis of Design: Bobrick Model B-6806X18 **(GB-18)**
      1) Length: 18 inches
   b. Basis of Design: Bobrick Model B-6806X36 **(GB-36)**
      1) Length: 36 inches
   c. Basis of Design: Bobrick Model B-6806 x 42 **(GB-42)**
      1) Length: 42 inches
2. Compliance: Barrier-free accessibility guidelines (including ADAAG) for structural strength.
   a. Capacity: Designed to support 900 lbs (408 kg) in compliant installations.
3. Description: Clearance between grab bar and finished wall is 1-1/2 inches
4. Grab Bar Materials: 18-8, Type 304, stainless steel tubing with satin finish.
5. Grab Bar Construction: 18 gauge (1.2 mm), ends heliarc welded to flanges.
6. Outside Diameter: 1-1/4 inch (32 mm).
7. Mounting: Concealed with manufacturer's standard flanges and anchors.

2.5 CUSTODIAL ACCESSORIES

MB-1 Custodial Mop and Broom Holder with Shelf:
1. Basis of Design: Bobrick Series Model B-224x36.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 36”
4. Hooks: Four.
5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
7. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
8. Location: Mounted over mop receptor. Coordinate mounting height.

2.6 FABRICATION

A. General: One, maximum 1-1/2-inch-diameter, unobtrusive stamped manufacturer logo, as approved by Architect, is permitted on exposed face of accessories. On interior surface not exposed to view or back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.

B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.

C. Recessed Toilet Accessories: Unless otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors and access panels with full-length, stainless-steel hinge. Provide anchorage that is fully concealed when unit is closed.

D. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

C. Install grab bars to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10 28 00

SECTION 10 44 16 - FIRE EXTINGUISHERS AND CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Portable fire extinguishers.
2. Fire-protection cabinets
3. Brackets for wall hung units.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.

1. Fire Extinguishers: Include rating and classification.
2. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of cabinet finish indicated.

C. Samples for Verification: For each type of exposed cabinet finish required, prepared on Samples of size indicated below and of same thickness and material indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1. Size: 6-by-6-inch-square Samples.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and cabinets through one source from a single manufacturer.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."

C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide extinguishers listed and labeled by FM.

1.5 COORDINATION

A. Coordinate size of cabinets to ensure that type and capacity of fire extinguishers indicated and provided by Owner under separate Contract are accommodated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Portable Fire Extinguishers:

a. J.L. Industries, Inc.
b. Larsen's Manufacturing Company.
c. Potter-Roemer; Div. of Smith Industries, Inc.
d. Watrous; Div. of American Specialties, Inc.

2. Semi Recessed Fire-Protection Cabinets:

a. J.L. Industries, Inc.
b. Larsen's Manufacturing Company.
c. Potter-Roemer; Div. of Smith Industries, Inc.
d. Watrous; Div. of American Specialties, Inc.

3. Fully Recessed Fire-Protection Cabinets:

a. J.L. Industries, Inc.
b. Larsen's Manufacturing Company.
c. Potter-Roemer; Div. of Smith Industries, Inc.
d. Watrous; Div. of American Specialties, Inc.

4. Security Grade Fire-Protection Cabinets:

a. J.L. Industries, Inc.
b. Larsen's Manufacturing Company.
c. Potter-Roemer; Div. of Smith Industries, Inc.
d. Watrous; Div. of American Specialties, Inc.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: Carbon steel, complying with ASTM A 366/A 366M, commercial quality, stretcher leveled, temper rolled.

2.3 PORTABLE FIRE EXTINGUISHERS

A. General: Provide fire extinguishers of type, size, and capacity for each cabinet and other locations indicated.

B. Multipurpose Dry-Chemical Type I: UL-rated 2-A:10:B:C, 5-lb nominal capacity, in enameled-steel container.

2.4 FIRE-PROTECTION CABINETS

A. FEC1 - Fully Recessed Fire Protection Cabinets
   a. Cabinet Construction: Provide manufacturer's standard semi-recessed box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames. Fire rated cabinets where located in fire rated wall assembly. #4 satin finishes stainless steel door and trim.
   b. Door Glazing: Manufacturer's standard, as follows:
      i. Verticle panel with pull handler and Saftey lock.
      ii. Clear Tempered Glass
      iii. Color: Clear.
   c. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam-action latch, or exposed or concealed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.
   d. Locations: See Coversheets Life Safety Code Plans
   Basis of Design: JL Industries Cosmopolitan Stainless Steel 1035V10 3/8” Flat trim, vertical Duo Door.

B. FEC2 - Semi Recessed Fire Protection Cabinets
   a. Cabinet Construction: Provide manufacturer's standard semi-recessed box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames. Fire rated cabinets where located in fire rated wall assembly. #4 satin finishes stainless steel door and trim.
   b. Door Glazing: Manufacturer's standard, as follows:
      i. Verticle panel with pull handler and Saftey lock.
      ii. Clear Tempered Glass
      iii. Color: Clear.
   c. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam-action latch, or exposed or concealed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.
   d. Locations: See Coversheets Life Safety Code Plans
   e. Basis of Design: JL Industries Cosmopolitan Stainless Steel C1037V10 3” rolled edge, verticle duo door.

C. FEC3 - Security Grade Fire Protection Cabinets
   a. Cabinet Construction: Provide manufacturer's standard semi-recessed box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames. Fire rated cabinets where located in fire rated wall assembly. 14 guage #4 satin finishes stainless steel door and trim.
   b. Door Hardware: Provide manufacturer's Detention grade deadbolt installed door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam-action latch, or exposed or concealed

door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

c. Locations: See Coversheets Life Safety Code Plans
d. Basis of Design: JL Industries: Security/Detention SFC-12 SSFC-32, stainless steel 2 ½" Square Trim.

2.5 ACCESSORIES

A. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Architect.

1. Identify fire extinguisher in cabinet with the words "FIRE EXTINGUISHER" applied to door.

a. Application Process: Silk-screened.
b. Lettering Color: Red.
c. Orientation: Vertical.

2.6 COLORS AND TEXTURES

A. Colors and Textures: As selected by Architect from manufacturer's full range for these characteristics.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Cabinet and Door Finishes: Provide manufacturer's standard baked-enamel paint for the following:

1. Exterior of cabinets and doors, except for those surfaces indicated to receive another finish.
2. Interior of cabinets and doors.

2.8 STEEL FINISHES

A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.

1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free, universal primer, selected for resistance to normal atmospheric corrosion, for compatibility with substrate and field-applied finish paint system indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

C. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.9 MOUNTING BRACKETS

A. Mounting Brackets: Provide manufacturer's standard steel, designed to secure fire extinquishers to wall or structure, of sizes required for types and capacities of extinquishers indicated, with plated or baked enamel finish.

1. Color: Red.

B. Identification: Lettering compling with authorities having jususdiction for lettering style, size, spacing, and location. Locate as indicated.

1. Identify bracket-mounted extinquishers with the words “FIRE EXTINQUISHER” in red letter decals applied to mounting surface.
2. Orientation: Vertical.

2.10 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Miter and weld joints and grind smoothly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for cabinets to verify actual locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets are to be installed.

C. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged units.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing fire-protection specialties.

B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Prepare recesses for cabinets as required by type and size of cabinet and trim style.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust cabinet doors that do not swing or operate freely.

B. Refinish or replace cabinets and doors damaged during installation.

C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 10 44 16

SECTION 10 51 13 – WELDED METAL LOCKERS & WOOD BENCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

Personal Storage Lockers, Personal Storage Lockers with built-in bench drawers, Personal Storage Lockers with built-in external access drawers and Personal Storage Lockers in Multi-tier Configuration, Evidence locker (non-pass through) with electric outlet and refrigerated components. Fire Rated Ammunition Locker, Gun Rack Lockers, Tactical gear open shelf lockers, Duty bag open shelf lockers.

1. Interior wood works, matchings solid wood bench returns and corners. Locker contractor shall provide the corner infill components as matching powder coated locker blanks with sole wood top provider continuing the bench.
2. Interior Solid wood benches ADA accessible.
3. Add Alternate No. 3: The Amount to be added to the total contract sum in connection with adding a single duplex receptacle to each of the welded metal personal storage lockers in the GN Locker Room (228), Women's Locker Room (229), and Men's Locker Room (230) and connecting them via the welded-metal locker manufacturer's plug-to-plug connector harness.

B. Related Work, Not Furnished:

1. Finish floor covering material and installation.

1.3 REFENCES

A. American National Standards Institute (ANSI) Standards:

Applicable standards for fasteners used for assembly.

B. American Society for Testing and Materials (ASTM) Standards:

Applicable standards for steel sheet materials used for fabrication

Applicable standards for the testing of electrostatically applied Powder Coat Paint

C. American Institute Of Steel Construction (AISC) Standards:

Applicable standards for steel materials used for fabrication.

1.4 DESCRIPTION

A. General: Welded Metal Lockers only with end-user reconfigurable interior. Specialized lances to provide the flexibility of on-site, end-user reconfiguration/addition of internal components anytime, anywhere, now or in the future.

B. Finishes:

Fabricated Metal Components and Assemblies: All components to be painted with an electro-statically applied Powder Coat paint that can meet or exceed test requirements set out by ASTM standard D3451-06 Standard Guide for Testing Coating Powders and Powder Coatings.

C. Sizes:

Personal Storage Lockers with built-in bench drawers: nominal heights of 72 inches; Built-in bench drawer nominal height is 18 inches and nominal depth is 24 inches.

Personal Storage Lockers in Multi-Tier configurations: see drawings

Fire rated Ammunition Storage Lockers: nominal height of 72 inches, and nominal widths of 30 inches.

1.5 PERFORMANCE REQUIREMENTS

A. Design Requirements:

Limit overall width not to exceed specified nominal width; locker width designed for zero growth.

B. Seismic Performance: Provide Welded Metal Lockers capable of withstanding the effects of earthquake movement when required by applicable building codes.

C. ADA Requirements: Personal Storage Lockers with nominal height of 72 inches meet ADA requirements.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation instructions for each type of welded metal locker required. Include data substantiating that products to be furnished comply with requirements of the contract documents.

B. Shop Drawings: Show fabrication, assembly, and installation details, including descriptions of procedures and diagrams. Show complete locker installation layout, including quantities, locations and types of accessory units required. Include notations and descriptions of all installation items and components.

Show installation details at non-standard conditions, if any.

Provide layout, dimensions, and identification of each unit, corresponding to sequence of installation procedures.

Provide installation schedule and procedures to ensure proper installation.

C. Samples: Provide minimum 3 inch square example of each color and texture on actual substrate for each component to remain exposed after installation.

D. Selection Samples: For initial selection of colors and textures, submit manufacturer's color charts, consisting of actual product pieces, showing full range of colors and textures available.

E. Warranty: Submit draft copy of proposed warranty for review by the Architect.

F. Maintenance Data: Provide written documentation of the manufacturer’s statement, claiming the maintenance free nature of the product.

G. Reference List: Provide a list of recently installed welded metal lockers to be visited by owner, architect, and contractor. Intent of list is to aid in verifying the suitability of manufacturer's products and comparison with materials and product specified in this section. Include contact name, address, and phone numbers.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engage an experienced manufacturer who is ISO 9001:2008 certified for the design, production, installation and service of welded metal lockers. Furnish certification attesting ISO 9001:2008 quality system registration.

B. Installer Qualifications: Engage an experienced installer who is the manufacturer's authorized representative for the specified products for installing welded metal lockers.

Minimum Qualifications: 1-year experience installing welded metal lockers of comparable size and complexity to specified project requirements.

1.8 DELIVERY, STORAGE AND HANDLING

A. Follow manufacturer’s instructions and recommendations for delivery, storage and handling requirements.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify quantities of welded metal locker units before fabrication. Indicate verified measurements on shop drawings. Coordinate fabrication and delivery to ensure no delay in progress of the work.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating welded metal lockers units without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.

1.10 SEQUENCING AND SCHEDULING

A. Sequence welded metal lockers [with other work] to minimize possibility of damage and soiling, during remainder of construction period.

B. Schedule installation of specified welded metal lockers after finishing operations, including painting, have been completed.

C. Provide components, which must be built in at a time, which causes no delays in the general progress of the work.

D. Pre-installation Conference: Schedule and conduct conference on project site to review methods and procedures for installing welded Metal Lockers including, but not limited to, the following:

Recommended attendees include:

1. Owner's Representative.
2. Prime Contractor or representative.
3. The Architect.
4. Manufacturer's representative.
5. Subcontractors or installers whose work may affect, or be affected by, the work of this section.

1.11 WARRANTY

A. Provide a written warranty, executed by Contractor, Installer, and Manufacturer, agreeing to repair or replace units, which fail in materials or workmanship within the established warranty period. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have under General Condition’s provisions of the Contract Documents.

B. Limited Lifetime Warranty: Subject to the terms in the written warranty, warrant the original purchaser exclusively that the locker frames manufactured by it will be free from defects in materials and workmanship for the lifetime of the locker.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. General: FreeStyle™ Personal Storage Lockers, FreeStyle™ Personal Storage with built-in bench drawers, Personal Storage with built-in external access drawers, FreeStyle™ Personal Storage Lockers in Multi-Tier configurations; based upon welded metal lockers manufactured by Spacesaver Corporation, 1450 Janesville Avenue, Fort Atkinson, Wisconsin 53538-2798. Telephone: 800-492-3434.; Basis of Design.

1. OR APPROVED EQUAL

2.2 BASIC MATERIALS

A. General: Provide materials and quality of workmanship, which meets or exceeds established industry standards for products specified. Use furniture grade sheet metal, solid hardwood

benches and fasteners for component fabrication unless indicated otherwise. Material thicknesses/gauges are manufacturer's option unless indicated otherwise.

2.3 LOCKER TYPES

A. Personal Storage Lockers. Vented peaked top. Provide standard personal storage lockers.

B. Personal Storage Lockers. Provide personal storage lockers with built-in bench drawers.

C. Personal Storage Lockers. Provide personal storage lockers with built-in external access drawers.

D. Personal Storage Lockers. Provide personal storage lockers in Multi-Tier configurations. Provide 4-tier lockers equipped with accessories as requested.

E. Note:

1. All locker types (except Multi-Tier) to be equipped with environmental ventilation functionality for applications where Mechanical Air Extraction is desired to remove unpleasant odors from the locker.
2. All locker types (except Multi-Tier) to be equipped with the functionality of attaching a modular electrical system as required.
3. All locker types to be equipped with the functionality of attaching a continuous sloped top.

2.4 MANUFACTURED COMPONENTS

A. Welded Frame:

1. The welded frame must consist of top, bottom, back, and sides constructed of a minimum of 18-gauge steel. All frame components shall be joined using resistance welding. Riveting of structural members will not be permitted.
2. Horizontal front flanges will be a minimum of 2 inch. Vertical front flanges will be a minimum of 1 inch. Horizontal and vertical flanges will overlap and be secured with a minimum two (2) resistance welds per corner.
3. Corner gussets shall be MIG and spot welded in each of the four front corners of the locker for increased stiffness and rigidity.
4. Provide side panel lances evenly spaced on 3 inch centers. Lances to provide the flexibility of on-site, end-user reconfiguration/addition of internal components anytime, anywhere, now or in the future.
5. Bench Housing for built-in bench drawer
6. Welded frame construction shall consist of top, bottom, and side components joined by using resistance welding. Riveting of bench housing structural members will not be permitted.
7. Corner gussets shall be welded in the two (2) front bottom corners of the bench housing for increased stiffness and rigidity.
8. Horizontal front flanges will be a minimum of inch.
9. Vertical front flanges will be a minimum of 1 inch.

10. Horizontal and Vertical front flanges will overlap and shall be secured with minimum of one (1) resistance weld per corner.
11. Side panels – Lances symmetric and evenly spaced to provide optimum component locations (standard based on 3 inch on center vertical placement to match mating locker lance design).
12. Return flanges on housing to securely fasten housing to welded frame of locker.
13. Base of bench housing shall include four (4) 3/8”-16 UNC threaded weld-nuts and corresponding leveling feet.
14. Top of bench housing shall include hole pattern for mating bench seat.
15. Sides of bench housing shall include mounting holes in the event lockers are ganged together.
16. Lockers with built-in bench drawer and built-in external access drawer shall have intermediate base shelf with interlocking mechanism for securing drawer when locker door is closed.
17. Provide four (4) [0.875] inch or [22.23] millimeter diameter electrical knock-outs per locker, two (2) located on top of the locker in both right and left rear corners, and two (2) located in the back of locker centered at a distance no greater than [24] inches from the top and bottom. Knock-outs allow end-user flexibility of adding electrical capability to lockers.
18. Provide a minimum of four (4) duplex receptacle electrical knock-outs per locker; to be used with a UL listed manufactured electrical wiring system as required. This manufactured electrical wiring system is a simple, unique, flexible, and cost effective method of providing electrical capability to the lockers. This electrical system can be added in the future.
19. Top of the locker shall have four (4) duplex electrical knock-outs.
20. Top of locker shall have electrical duplex receptacle knock-outs located on both right and left side of locker.
21. Back panel of locker shall have a minimum of two (2) duplex electrical knock-outs.
22. Back of locker shall have electrical duplex receptacle knock-outs located on both right and left side of locker and no farther than [24] inches or [609.6] millimeters from the top of the locker.
23. Provide passive ventilation holes in top of locker to allow mechanically extracted air to be pulled up through the locker system as required. Ventilation shall be controlled by eight (8) evenly spaced [0.625] inch diameter holes. Proper ventilation system ensures unpleasant odors are removed from locker system.
24. Lockers shall be prepared with mounting holes for use with the continuous sloped top system.
25. Lockers shall be prepared with mounting holes for attaching necessary trim components
26. Locker shall be prepared with mounting holes for ganging lockers back-to-back or side-by-side
27. Base of lockers shall include four (4) 3/8”-16 UNC threaded weld-nuts and corresponding leveling feet.

28. Base shelf for lockers with built-in external access drawers and bench drawers shall have holes to accommodate double-door lock rod and door stop bracket. (only on 24 inch or [609.6] millimeters wide and larger)
29. End Panels: End Panels with no exposed fasteners shall be provided on the end of each locker run; thus providing a clean and aesthetically pleasing appearance.
30. All locker sizes and types to be specified by architect.
31. Width:
    1) Personal Storage Locker: 34 inches
    2) Personal Storage Locker with built-in bench drawer or external access drawer: 24 inches
    3) Personal Storage Lockers in Multi-Tier configuration:24 inches

b. Height:
    1) Personal Storage Locker: 72 inches
    2) Personal Storage Locker with built in bench drawer or external access drawer: 72 inches
    3) Personal Storage Locker in Multi-Tier configuration: 72 inches

c. Depth:
    1) All lockers 24 inches
    2) Bench drawers: 24 inches
        c) Bench seat depth 9.5 inches
        c) Leading edge of bench seat to extend 1.125 inches from front of bench drawer
    3) External access drawer: 24 inches

B. Ventilation:

1. Provide ventilation holes in top of locker to allow mechanically extracted air to be pulled up through the locker system as required. Ventilation shall be controlled by eight (8) evenly spaced 0.625 inch diameter holes. Proper ventilation system ensures odors are removed from locker system.
2. Provide an adjustable air baffle for system balancing when mechanical air extraction is used. Upon balancing system, air baffle shall be secured with a fastener to maintain ventilation setting.
3. Provide louvered air vents in bottom of the main locker door/s to allow mechanically extracted air to be pulled up through the locker system.
4. Provide louvered air vents in drawer front when built-in bench drawer or built-in external access drawer models are required.
5. Minimum 0.500 inch gap between back of shelving components and back of locker to provide uninterrupted air flow up the rear of the locker system.
6. Minimum 2.00 inches gap between front of shelving and locker door to provide uninterrupted air flow up the front of the locker system.

7. Multi-Tier ventilation is provided thru door panels
8. Lockers shall have passive ventilation.

C. Drawers (for bench drawer and external access drawer):

1. Drawer body wrapper shall have welded frame construction. Riveting of structural members will not be permitted.
2. Drawers for locker with built-in bench drawers and built-in external access drawers shall have box-formed drawer front.
3. Provide interlock system for securing drawer when main locker doors are closed and provide access only when main locker door/s is opened.
4. Built-in bench drawer shall have a nominal 36 inches depth.
5. Provide a flush mounted pull handle.
6. Drawer Slides: Provide 200 lbs maximum load capacity and pass 50,000 cycle performance testing (Max. load, uniform distribution) (Test data to be provided by manufacturer upon request)
7. Drawer base minimum 21 drawer extension
8. Bench drawer minimum 26.5 inches drawer extension
9. Provide louvered air vents in drawer front when built-in bench drawer or built-in external access drawer models are required.
10. Provide capability of attaching glides for Body Armored Drying Rack, as requested.

D. Bench Seat:

1. Provide 9.5 inches deep laminated kiln dried maple bench seat; material thickness 1.25 inches.
2. Front (leading edge) of bench seat to have .625 inch radius bull nose.
3. Finish of bench seat shall be sanded smooth and have two (2) coats of catalyzed varnish applied. See Painting Specification for stain and polyurethane coating.

E. Single-Piece Welded Doors (Single and Double Door Models):

1. Shall be formed from two (2) pieces of minimum 18-gauge cold rolled steel box formed and welded together using modern GMAW techniques. Single-piece door with inner and outer door panels shall have a combined steel thickness of no less than 0.096 inches thick. Welded door design with inner panel optimizes structural integrity of locker door system over and above any single frame door design.
2. Exterior door panel shall be constructed with formed flanges and return flanges to add stiffness.
3. Internal door panel shall be constructed with formed flanges for added stiffness.
4. All inner door panel (except Multi-Tier) heights shall be minimum 70% of external door height.
5. Multi-Tier inner door panels shall be full height.
6. Single-piece welded door frame shall consist of internal door panel nested inside exterior door panel and welded per the following requirements:

7. Top / bottom. Exterior and Interior panels to be welded in a minimum of three (3) places with weld spacing not to exceed 6 inche between adjacent welds and 1 inch from any corner.
8. Sides. Exterior and interior panels to be welded with spacing not to exceed 12] inches between adjacent welds and 1inch or from any corner.
9. Inner door panel to have peg board style hole pattern, allowing the attachment of Document Holder and any standard peg board accessory.
10. Inner door panel to have 4 inch rectangular slot centered towards the top of the locker.
11. External door panel shall have louvers to provide adequate air circulation throughout locker system.
12. Louvered air vents shall be located at the bottom of the locker door to enhance circulation of mechanically extracted air from the bottom of the locker out of the top.
13. Louvered air vents shall be approximately 3 inches in width and 0.75 inches in height and spaced on 1 inch or centers.
14. Double door designs shall consist of the following:
15. Design available in 30 locker widths
16. Primary door located on the right and the secondary door located on the left-hand side of the locker.
17. Secondary door locking mechanism shall consist of the following:
    1) Return flange for supporting primary door
    2) Catch bracket
    3) One lower lock rod
18. All doors shall have neoprene silencers on each door for noise reduction
19. Door torsional deflection shall not exceed [0.1875] inch or [4.76] millimeter with a [20] lb or [9.071] kilogram point load. (Test data to be provided by manufacturer upon request)
20. Hinge:
21. Provide 16-gauge full length hinge for increased strength and security of locker system.
22. Hinges to be welded to door frame with spot welds not to exceed 6 inch separation.
23. Door assembly to be riveted to door frame on factory pre-established hole pattern.
24. Locking Mechanism.
25. Provide three locking options (all locking options have protective stainless steel cover plate for durability and scratch resistance):
    1) Padlock hasp only.
    2) Keyed lock with master and padlock hasp.
    3) Combination lock with master and padlock hasp.

    b. Keyed and combination locking mechanisms shall have the capability of locking automatically.

c. Keyed and Combination locking mechanisms shall have master key override.

d. Combination locking mechanism shall have user changeable preset combinations.

26. Single door models: Provide three locking options as listed above.

27. Double door models: Provide three locking options on the primary door and simple secure lift latch mechanism with 0.3125 inch lock rod for secondary door.

F. Interior/Accessory components:

1. All interior components must be constructed of minimum 18-gauge steel (unless otherwise clarified in specification).

2. For added security, internal component can be secured utilizing blind rivets, threaded fasteners, or bending specially designed tab.

3. All interior components available at time of order and as post-installation upgrades in the future.

4. Shelves (available all locker models)

5. Shelf with integral hanger bracket

1) Size specified by locker width

2) Hanger bracket designed with perforations on approximately 3 inch centers to insure clothing separation for optimum ventilation

3) Performance: Uniform load rating [300] lbs

6. Plain

1) Size specified by locker width

2) Performance: Uniform load rating 100 lbs

b. Heavy Duty

1) Size specified by locker width

2) Performance: Uniform load rating 300 lbs

c. Perforated (use as drying rack)

1) Size specified by locker width

2) Tested performance: Uniform load rating 100 lbs

d. Shelf rear return flange stops minimum 0.50 inch or short of locker back panel on order to allow air circulation throughout entire locker assembly

e. All performance test data shall be provided by manufacturer upon request.

7. Modular Shelf (available in all models except Multi-Tier)

8. Provides storage compartment for smaller items

9. Approximate compartment size: 9 inches or wide and 12 inches high

10. Optional extended height of 24 inches available

11. Modular shelves to have tabs to interlock with frame side panel lances

12. Modular shelves vertical sides to have lances that match with opposing side panel lances.

13. Modular shelves shall have two (2) locations on vertical side panel for attaching hooks, and one (1) location on bottom for attaching double hook accessories.
14. Shelf rear return flange stops approximately 1 inch short of locker back panel on order to allow air circulation throughout modular shelf.
15. Provide modular shelf with slots for connection with file dividers and shelf back stop. File dividers will aid in maintaining a neat and orderly locker system.
16. Provide lockable compartment for small valuables (available in all models except Multi-Tier)
17. Lockable compartment shall be integral to modular shelf accessory
18. Provide a 14-gauge padlock-able compartment door.
19. Provide [0.188] inch diameter zinc plated steel hinge rod.
20. Door to be mounted with zinc plated steel hinge rod and two shoulder washers for smooth, quiet operation.
21. Provide an 18-gauge hasp bracket for securing lockable compartment door.
22. Adjustable Shelf (available in all models except Multi-Tier)
23. Integral with modular shelf
24. Shelf to have tabs to interlock with frame side panel and modular shelf lances.
25. Shelf shall contain slots for file divider accessories as previously defined
26. Vinyl Mat (modular shelf) (available in all models except Multi-Tier)
27. Material – Vinyl
28. Color – Black
29. Type – longitudinal round corrugated ribs
30. Document Holder (available in all models except Multi-Tier)
31. Width – 10.5 inches
32. Height – 6 inches
33. Depth – 1.5 inches
34. Design to include matching hole pattern to allow various attachment locations on inner door panel
35. Mirror
36. Material – 0.0625 inch thick plastic with mirror surface on one side
37. .0625 inch thick flexible magnet attached to non-mirrored side
38. Size – 3.875 inche height and 5.875 inches width
39. Boot Tray
40. Material – Rubber
41. Dimensions:
    1) Width – 12.9 inches
    2) Depth – 19.90 inches

3) Height –1.25 inches

42. Manufactured from Natural rubber compounds, environmentally friendly, durable, water repellant easily cleaned with soap and water, resistant to alkalis and weak acids, mold, mildew, and dust mites.
43. Body Armor Drying Rack
44. Shall be available in bench drawer model widths of 30
45. Size of tray is controlled by locker width
46. Bottom of drying tray shall have louvered pattern to provide air circulation throughout
47. Shall have the ability to adjust/glide frontward and backward, while mounted in the bench drawer.
48. Internal Drawers
49. Shall be available in all 30 inch wide locker models
50. Drawer shall have a depth of approximately 19 inches
51. Shall be available in 6, 9 inch height, respectively.
52. Drawer shall have locking option when specified by customer/architect
53. Drawer shall have a tested weight capacity rating of 50 lbs
54. File Dividers (modular shelf) (available in all models except Multi-Tier)
55. Hooks
56. Single Hooks – shall have the ability to attach single hooks on the side of the Modular Shelf and on the side panel lances
57. Double Hook – shall have the ability to attach a double hook to the underside of the Modular Shelf
58. Hook Bracket Hanger Assembly – shall have the ability to attach a three-hook bracket assembly to any lanced location on the side panels of the locker.

G. HVAC
1. NOT USED

H. Locker Tag Numbers
1. Shall provide locker numbers on each locker per customer requirement

2.5 SOLID WOOD LOCKER ROOM ADA BENCHES

A. ADA-compliant wood locker benches: Constructed of solid butcher block wood that is 1-1/4” (31.75 mm) thick; includes two 3 inch (76 mm) diameter bolt mounted pedestals in a black powder coated finish; pedestals include four (4) mounting holes to secure to the ground; combines a classic look with strength and durability. Requires minor assembly.

B. Basis of Design Manufacturer: Salsbury Industries, 18300 Central Avenue, Carson, CA 90746-4008; Toll Free Tel: 800-LOCKERS (800-562-5377); Fax: 800-562-5399; Email: salsbury@lockers.com; Website: www.lockers.com. Model # 77781-ADA-LGT

1. School Lockers.com
2. Republic Storage Products
3. Lyon Storage Solutions
4. Or approved equal
5.

C. Description:

1. Dimensions: 48" W x 18" H x 20" D
2. Meets ADA Seating requirements.
3. 1-1/4” thick solid wood top.
4. Set on two (2) bolt mounted pedestals in an aluminum powder coated finish, bolted to slab.

2.6 FABRICATION

A. General: Coordinate fabrication and delivery to ensure no delay in progress of the work.

2.7 FINISHES

A. Colors: Selected by architect from manufacturer’s standard available colors.

B. Paint Finish: Textured (Standard) – Provide factory applied electrostatic powder coat paint. Meet or exceed specifications of the American Society for Testing and Materials (ASTM) Standards:

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Lockers scheduled to receive accessories [with Installer present] for compliance with requirements for installation tolerances and other conditions affecting performance of specified accessory items.

B. Proceed with accessory installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Follow manufacturer’s written instructions for installation of each type of accessory item specified.

3.3 FIELD QUALITY CONTROL

A. Verify accessory unit alignment and plumb after installation. Correct if required, following manufacturer's instructions.

B. Remove components that are chipped, scratched, or otherwise damaged and which do not match adjoining work. Replace with new matching units, installed as specified and in manner to eliminate evidence of replacement.

3.4 ADJUSTING

A. Adjust all accessories to provide smoothly operating, visually acceptable installation.

3.5 CLEANING

A. Immediately upon completion of installation, clean components and surfaces. Remove surplus materials, rubbish and debris, resulting from installation, upon completion of work and leave areas of installation in neat, clean condition.

3.6 DEMONSTRATION/TRAINING

A. Schedule and conduct demonstration of installed accessory items and features with Owner's personnel.

B. Schedule and conduct maintenance training with Owner's maintenance personnel. Training session should include lecture and demonstration of all maintenance and repair procedures that end-user personnel would normally perform.

3.7 PROTECTION

A. Protect system against damage during remainder of construction period. Advise owner of additional protection needed to ensure that system will be without damage or deterioration at time of substantial completion.

END OF SECTION 10 51 13

SECTION 10 51 13.1 – METAL EVIDENCE LOCKERS AND HANDGUN LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

Standard and Refrigerated Non Pass-thru Evidence Lockers, and Handgun Lockers

B. Related Work, Not Furnished:

Finish floor covering materials and installation.

C. Related Sections:

Sections in Division 9 – Finishes, relating to finish floor and base materials.

1.3 REFERENCES

A. American National Standards Institute (ANSI) Standards:

Applicable standards for fasteners used for assembly.

B. American Society for Testing and Materials (ASTM) Standards:

Applicable standards for steel sheet materials used for fabrication.

Applicable standards for the testing of electrostatically applied Powder Coat Paint

C. American Institute Of Steel Construction (AISC) Standards:

Applicable standards for steel materials used for fabrication.

1.4 DESCRIPTION

A. General: Metal Evidence Lockers & Gun Lockers

B. Location: Metal Evidence Locker in the Evidence Processing Room. The Gun Lockers are noted in the floor plans and elevations they are include in places where on officer disarms in the adjacent spaces, holding and public areas.

C. Finishes:

Fabricated Metal Components and Assemblies: All components to be painted with an electrostatically applied Powder Coat paint that can meet or exceed test requirements set out by ASTM standard D3451-06 Standard Guide for Testing Coating Powders and Powder Coatings.

D. Sizes:

Available in nominal heights of 82 inches

Available in nominal widths of 36 inches as noted on drawings.

Available in a nominal depth of 24 inches as noted on drawings.

1.5 PERFORMANCE REQUIREMENTS

A. Design Requirements:

B. Limit overall width to 0.032 inches greater or less than the nominal specified width.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation instructions for each type of evidence lockers required. Include data substantiating that products to be furnished comply with requirements of the contract documents.

B. Shop Drawings: Show fabrication, assembly, and installation details including descriptions of procedures and diagrams. Show complete extent of evidence lockers installation layout including quantities, locations and types of accessory units required. Include notations and descriptions of all installation items and components.

Show installation details at non-standard conditions, if any.

Provide layout, dimensions, and identification of each unit corresponding to sequence of installation procedures.

Provide installation schedule and procedures to ensure proper installation.

C. Samples: Provide minimum 3 inch square example of each color and texture on actual substrate for each component to remain exposed after installation.

D. Selection Samples: For initial selection of colors and textures, submit manufacturer's color charts consisting of actual product pieces, showing full range of colors and textures available.

E. Warranty: Submit draft copy of proposed warranty for review by the Architect.

F. Maintenance Data: provide written documentation of the manufacturer’s statement claiming the maintenance free nature of the product.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engage an experienced manufacturer who is ISO 9001 certified for the design, production, installation and service of evidence lockers. Furnish certification attesting ISO 9001 quality system registration.

B. Installer Qualifications: Engage an experienced installer who is a manufacturer's authorized representative for the specified products for installing evidence lockers.

Minimum Qualifications: 1-year experience installing evidence lockers of comparable size and complexity to specified project requirements.

1.8 DELIVERY, STORAGE AND HANDLING

A. Follow manufacturer’s instructions and recommendations for delivery, storage and handling requirements.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify quantities of evidence lockers before fabrication. Indicate verified measurements on Shop Drawings. Coordinate fabrication and delivery to ensure no delay in progress of the Work.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating evidence lockers units without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.

1.10 SEQUENCING AND SCHEDULING

A. Sequence evidence lockers units with other work to minimize possibility of damage and soiling during remainder of construction period.

B. Schedule installation of specified evidence lockers after finishing operations; including painting have been completed.

C. Provide components which must be built in at a time which causes no delays general progress of the Work.

D. Pre-installation Conference: Schedule and conduct conference on project site to review methods and procedures for installing evidence lockers including, but not limited to the following:

Recommended attendees include:

1. Owner's Representative.
2. Prime Contractor or representative.
3. The Architect.
4. Manufacturer's representative.

5. Subcontractors or installers whose work may affect, or be affected by the work of this section.

1.11 WARRANTY

A. Provide a written warranty executed by Contractor, Installer and Manufacturer, agreeing to repair or replace units which fail in materials or workmanship within the established warranty period. This warranty shall be in addition to and not a limitation of other rights the Owner may have under the General Conditions provisions of the Contract Documents.

B. Limited Lifetime Warranty: Subject to the terms in the written warranty, warrant the original purchaser exclusively that the locker frames manufactured by it will be free from defects in materials and workmanship for the lifetime of the locker. Warrant the original purchaser exclusively that all moving parts manufactured by it will be free from defects in materials and workmanship for 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. General: Products known as DSM Evidence Lockers are based upon evidence lockers manufactured by Spacesaver Corporation, 1450 Janesville Avenue, Fort Atkinson, Wisconsin 53538-2798. Telephone 866-276-0445; Basis of Design.

2.2 BASIC MATERIALS

A. General: Provide materials and quality of workmanship, which meets or exceeds established industry standards for products specified. Use furniture grade sheet metal and fasteners for component fabrication unless indicated otherwise. Material thicknesses/gauges are manufacturer’s option unless indicated otherwise.

2.3 LOCKER TYPES

A. Evidence lockers Assortment of sizes to be 5/8th of a 6’ x 8’ of locker area. See drawings for sizes.

B. Refrigerated evidence lockers Assortment of sizes to be 3/8th of a 6’ x 8’ of locker area.

2.4 MANUFACTURED COMPONENTS, STANDARD EVIDENCE LOCKERS

A. Welded Frame:

1. The welded frame is structural and shall consist of top, bottom, back and sides constructed of a minimum of 18 gage steel. All frame components shall be joined using resistance welding. Riveting or bolting of structural members will not be permitted.

2. Horizontal and vertical outer front flanges will be a minimum of 1.5 inches. Horizontal and vertical flanges will overlap with a minimum of 2 resistance welds per corner.

3. Center vertical lock housing is structural and will run the full height and depth of the locker. All locks will be completely enclosed by a full height removable panel. Pass-thru rear release mechanisms will be completely enclosed by the lock housing and accessible only when the rear door is open. Provide engagement points for the anti-pry tabs that are on all front doors.

4. Exposed lock mechanisms that can snag evidence and be obstructed by stored articles will not be permitted.

B. Welded Bases:

1. Each welded base shall be permanently affixed to each locker using modern Inert Gas Metal Arc Welding techniques for lateral unit stability. The base shall be a minimum of 14 gage (1.98MM) steel 4 inches high with a 1.5 inch return on the bottom for support.

2. Provide four 0.375 inch mounting holes and four 0.375 inch nuts welded in place for the mounting of floor levelers. Provide four appliance levelers per locker.

3. Provide removable access panels for access to mounting holes and leveling points.

C. Shelves:

1. Shall be a single-piece formed from a minimum of 18-gage cold rolled steel with a double 90-degree bend on the rear of the shelf and a double 90-degree bend on the front of the shelf. Shelf sides shall be turned up 90-degrees for ease of cleaning and to prevent debris from becoming caught between the shelf and the sidewall.

2. All shelves shall be welded into place. Rivets, screws, bolts or other loose fasteners will not be permitted for the fastening of shelves to the locker frame.

D. Locks:

1. Patent Pending. Lock shall be push button locking with a stainless steel push button and alignment bezel. Locks shall be a one-piece removable design. Locks will secure the door with the single push of a button with no other action required by the user.

2. Locks will be deadbolt type locks with multi-point engagement. Rotary latches or cam locks will not be tolerated.

3. Pass-thru locks will be reset from the rear of the locker when the rear door is in the open position only.

4. Non Pass-thru locks will be reset from the front of the locker using tube type locks keyed to differ.

5. Provide documentation for cycle testing where locks are tested successfully to a minimum 40,000 cycles without failure.

6. Locks shall be pre-lubricated with no maintenance required for the lifetime of the unit (estimated at 20 years).

E. One Piece Welded Doors:

1. Shall be formed from two pieces of minimum 18-gauge cold rolled steel box formed and welded together using modern GMAW techniques. The one piece door with inner and

outer door skins shall have a combined steel thickness of no less than 0.096 inches thick.

2. Each door shall have a nickel plated, flush mounted door handle installed with fasteners visible only in the unlocked position.
3. Provide neoprene silencers on each door.
4. Provide anti-pry tabs that engage with the Center Vertical Lock Housing when the door is locked.
5. Doors shall have no moving parts except the door and the hinge.
6. Provide stainless steel spring loaded hinges that are welded to prevent pin removal. Spring loaded hinges shall be capable of holding the door closed and flush with the door frame. Doors that hang ajar are a safety concern and will not be tolerated.

F. Rear Doors (Pass-thru lockers)

1. Shall be formed from two pieces of minimum 18-gauge cold rolled steel box formed and welded together using modern Inert Gas Metal Arc Welding techniques. The one piece door with inner and outer door skins shall have a combined steel thickness of no less than 0.096 inches thick.
2. Each locker module shall have one rear door each and allow evidence to be removed from all compartments at once.
3. Each rear door shall have multi-point engagement with a built-in L handle lock. Access to all lock mechanisms shall be hidden behind cover plates that are secured with tamperproof fasteners.

2.5 MANUFACTURED COMPONENTS, REFRIGERATED EVIDENCE LOCKERS

A. Small Refrigerators

1. Available with 2, 3 or 4 compartments each individually locking without keys.
2. Factory installed into a standard evidence locker.
3. Pass-thru is emptied and reset from the rear at the push of a button.
4. Non pass-thru is emptied and reset from the front with a keyed release mechanism.
5. Shall have a stainless steel interior with spring loaded door hinges to hold each door closed.
6. Shall have magnetic seals on outer door[s.]
7. Shall have circulation fans that can maintain a consistent temperature throughout the interior of the fridge.
8. Shall have digital controls with settings preset to maintain 38º to 42º Fahrenheit.
9. Shall have an audible alarm.
10. Shall have circulation fans that can maintain an even temperature throughout the interior of the fridge.
11. Shall have digital controls with all settings preset to maintain 38º to 42º Fahrenheit.
12. Shall have an audible alarm

13. Non pass-thru is emptied and reset from the front with a keyed release mechanism
14. Shall have a stainless steel interior and exterior and use 100% CFC free polyurethane foam insulation
15. Shall have magnetic seals on outer door[s.]
16. Chamber cooling provided via cold (forced) air circulation
17. Shall have digital controls with all settings preset to maintain 38º to 42º Fahrenheit.
18. Shall have an audible alarm.

2.6 FABRICATION

A. General: Coordinate fabrication and delivery to ensure no delay in progress of the Work.

2.7 FINISHES

A. Colors: Selected from manufacturer's standard available colors.

B. Paint Finish: Provide factory applied electrostatic powder coat paint. Meet or exceed specifications of the American Society for Testing and Materials (ASTM) standards.

2.8 HANDGUN LOCKERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. General: Products known as DSM wall-mounted Handgun Locke, Models #EDHGS & EDHGF, flush mounted or surface mounted, manufactured by Spacesaver Corporation, 1450 Janesville Avenue, Fort Atkinson, Wisconsin 53538-2798. Telephone 800-255-8170; Basis of Design.
Or –Stainless Steel Drop Door Detention Pistol Locker KM-DPL-DD, Three door. Standard Exterior Pistol Locker Cabinet Body: 10"D x 20"W x 24"H.
OR approved equal

2.9 HANDGUN LOCKER MATERIALS

A. 16 gauge sheet steel: commercial quality, stretcher leveled, or roller leveled to stretcher-leveled flatness, free of buckling, scale and surface imperfections.

B. Fasteners; 5/32-inch steel rivets.

C. Hardware and Equipment; Manufacturer's standard product.

D. Body: Welded Modular Construction; Form backs, tops, bottoms, sides, and intermediate partitions from steel sheet; fabricated to form tight joints between components and no apparent gaps. Comply with the following:

1. Back-Material Sheet Thickness: .0598-inch 16-gauge steel.
2. Exposed Ends: Form exposed ends of non-recessed lockers from minimum .0598-inch, 16-gauge, steel sheet.

E. Trim surround for flush mount:

1. Single piece of formed .0598-inch, 16-gauge steel.
2. Surround mounted to locker with 5/32-inch steel rivets.
3. Holes for fastening to the wall must accept minimum 1/4-inch diameter fastener.

F. Doors: One-piece steel sheet, formed into Pan shape. Fabricate to prevent flexing when opening or closing, and to swing open approximately 170 degrees. Comply with the following:

1. Sheet Thickness: .0478-inch, 18-gauge, minimum.
2. Provide bumpers for cushioning of door closing.
3. Solid weld corners and polish smooth.

G. Hinges: Tube locks keyed different with master keys supplied.

H. Gun Locker Accessories: Number Plates: Manufacturer's standard etched, embossed, or engraved, plastic number plates with numerals at least 1/2-inch high. Numbering system shall be a three-digit number, sequenced as specified. Plates to be attached by (2) aluminum rivets and centered near the top on each door. Cushioning: 1/8-inch neoprene pad in bottom of openings.

I. Warranty: Provide the manufacturers 4 year limited parts and labor warranty.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine evidence lockers scheduled to receive accessories with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of specified accessory items.

B. Proceed with accessory installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Follow manufacturer's written instructions for installation of each type of accessory item specified.

3.3 FIELD QUALITY CONTROL

A. Verify accessory unit alignment and plumb after installation. Correct if required following manufacturer's instructions.

B. Remove components that are chipped, scratched, or otherwise damaged and which do not match adjoining work. Replace with new matching units, installed as specified and in manner to eliminate evidence of replacement.

3.4 ADJUSTING

A. Adjust all accessories to provide smoothly operating, visually acceptable installation.

3.5 CLEANING

A. Immediately upon completion of installation, clean components and surfaces. Remove surplus materials, rubbish and debris resulting from installation upon completion of work and leave areas of installation in neat, clean condition.

3.6 DEMONSTRATION/TRAINING

A. Schedule and conduct demonstration of installed accessory items and features with Owner's personnel.

B. Schedule and conduct maintenance training with Owner's maintenance personnel. Training session should include lecture and demonstration of all maintenance and repair procedures that end user personnel would normally perform.

3.7 PROTECTION

A. Protect system against damage during remainder of construction period. Advise Owner of additional protection needed to ensure that system will be without damage or deterioration at time of substantial completion.

END OF SECTION 10 51 13.1

SECTION 105113.2 – METAL LOCKERS – SECURED WEAPONS STORAGE CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Universal Weapons Rack
2. Fire-Rated Ammo Safe

1.3 REFERENCES

A. ARMY Regulation AR190-11

1. Applicable military requirements for the physical security of conventional arms, ammunition, and explosives.

B. Department of the NAVY OPNAV Instruction 5530.13C:

1. Applicable military requirements for physical security instruction for conventional arms, ammunition, and explosives.

C. Department of Defense DOD5100.76-M

1. Applicable military requirement for the physical security of sensitive conventional arms, ammunition, and explosives.

D. American National Standards Institute (ANSI) Standards:

1. Applicable standards for fasteners used for assembly.

E. American Society for Testing and Materials (ASTM) Standards:

1. Applicable standards for steel sheet materials used for fabrication.

F. American Institute of Steel Construction (AISC) Standards:

1. Applicable standards for steel materials used for fabrication.

1.4 DESCRIPTION

A. Secured Weapons Storage Cabinets: Assemblies consist of fully-welded, heavy-gauge steel cabinets available in six heights to accommodate weapons of varying lengths. All five cabinets are either [22.38] inches [56.8} millimeters or [42.38] inches [1076] millimeters

wide and [16.25] inches [412] millimeters deep. Cabinets must have built-in, folding, retractable cabinet doors that retract completely inside the cabinet when fully open so there are no swinging doors to obstruct the aisle way. The doors have heavy-gauge steel, rotating locking bars to provide maximum security according to military requirements for the physical security of conventional arms, ammunition, and explosives (OPNAVINST 5530.13C). Cabinet doors at minimum shall have nine (9) interlocking contact points. Manufacturer must provide supporting documentation that a DoD authority has approved the rack for use in a small arms vault and that they have the ability to have NSN's assigned to their rack if not completed already. This documentation must come on official letterhead or racks must come with NSN (National Stock Number) on the rack. Locking bars shall lock at a single common point and be able to accept a DoD issued and approved padlock. (Lock not included.) Locking bars shall require no effort to open so that when the padlock is removed, the locking bars drop due to gravity and arms room personnel have immediate access to weapons. Key locks are not acceptable, Sliding lock bars are not acceptable as they are prone to sticking and can slow down the ability to issue weapons in a timely manner. Handles that impede aisle or create catch points are not acceptable. Handles require extra motion and slow accessibility to weapons while cumbersome to operate.

B. Durability of Weapons Storage Cabinets: Cabinets must be fully welded with heavy-gauge steel built around a 4-Post structure to ensure durability and strength of cabinet. Cabinet walls must be a minimum of 18-gauge steel. Top and bottom of cabinet must be a minimum 16-gauge steel. Cabinets must be able to be stacked two levels high. Cabinet structure must be able to support a minimum of 1,500 lbs.

C. Visibility: The doors, sides, and back of the cabinet are perforated with a diamond mesh pattern to allow visible counts or weapon inventory to be taken even when the cabinet is closed and locked.

D. Space-Efficiency: System must have fully retractable doors so they don't impede aisle ways or adjoining cabinets when issuing weapons. Bi-fold doors are not acceptable as they still impede an aisle-way which could cause them to become damaged, thus leaving a potential quality issue. All racks provided must be of the same footprint to allow for double stacking and efficient use of the armory. When using one tall cabinet vs. two shorter cabinets, manufacturer must demonstrate the ability to meet all ODA configurations in the least amount of space. Depth of the racks should allow for storage of weapons with any site or optic attached to the weapon with doors closed.

E. Flexibility: Weapon rack cabinets must allow for "A La Carte" configurability to allow for storage of a wide range of weapon types, gear, optics, and spare barrels without making structural modifications to the rack. All individual components (pistol hooks, standard barrel supports, stock cups) must have NSN's for future sustainability or reset of rack system in the field. If individual components do not have NSN's then proof of the ability to obtain NSN's or that they are in the process of getting NSN's, must be demonstrated.

F. Multipurpose Back Panel: Weapon racks shall come with an optional multipurpose back panel kit. This back panel kit shall support a minimum of 700 lbs and be able to accept all weapon rack accessories. Accessories must be confined to the inside of the rack and not protrude outside of the rack in any way (including fasteners). Back panel kits must be capable of fitting all previous weapon rack cabinets.

G. Protection of Weapons: All components that come into contact with the weapons must be either dipped in a black poly vinyl chloride coating, made with an injection-molded

thermoplastic, or an over molded rubber. These materials must be designed and capable of withstanding extreme temperature and protect weapons from abrasions.

H. Safety: There must not be any exposed bolts, screws, or sharp edges on finished product. If barrel support are screwed or secured in place inside the rack, they must not protrude out the back or the rack to expose any sharp edges.

I. Finishes:

1. Fabricated Metal Components and Assemblies: Manufacturer's standard powder coat paint finish.

J. Sizes: See Drawings ROOM ARMORY 115

1. Width 42.38 inches.
2. Nominal Height 61

K. Military Testing (Mandatory)

L. Cabinets must have passed the most stringent military tests, including but not limited to the "Basic Shock/Accidental Load Test" and meets the requirements of OPNAVINST 5530.13C, AR190-11, DOD5100.76-M. Upon request manufacturers must be able to provide functional cycle testing documentation that doors pass with no visible sign of wear after 50,000 cycles.

1.5 PERFORMANCE REQUIREMENTS

A. Design Requirements: Provide secured weapons storage cabinets manufactured in sizes and dimensions, which will install free-standing or fit Spacesaver® mobile storage units. Reference AR190-11, OPNAV Instruction 5530.13C, DOD 5100.76-M for military requirements.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation instructions for each type of secured weapons storage cabinet. Include data substantiating that products to be furnished comply with requirements of the contract documents.

B. Shop Drawings: Show fabrication, assembly, and installation details including descriptions of procedures and diagrams. Show complete extent of secured weapons storage cabinet installation layout including quantities, locations and types of accessories required. Include notations and descriptions of all installation items and components.

1. Show installation details at non-standard conditions, if any.
2. Provide layout, dimensions, and identification of each secured weapons storage cabinet corresponding to sequence of installation and assembly procedures.
3. Provide installation schedule and complete assembly procedures to ensure proper installation.

C. Samples: Provide minimum [3] inch [76] millimeters square example of the color and texture on actual substrate for the rack that will remain exposed after installation.

D. Warranty: Submit draft copy of proposed warranty for review by the owner.

E. Maintenance Data: Provide in form suitable for inclusion in maintenance manuals for secured weapons storage cabinets. Data shall include operating and maintenance instructions, parts inventory listing, purchase source listing, emergency instructions, and similar information.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engage an experienced manufacturer who is ISO 9001 certified for the design, production, installation and service of secured weapons storage cabinets, carriage mounted high-density mobile storage units and support rails. Furnish manufacturer’s certification attesting ISO 9001 quality system registration.

B. Installer Qualifications: Engage an experienced installer who is a manufacturer's authorized representative for the specified products for installing weapons storage cabinets and anchoring cabinets to carriages.

1. Minimum Qualifications: 1-year experience installing systems of comparable size and complexity to specified project requirements.

1.8 DELIVERY, STORAGE AND HANDLING

A. Follow manufacturer’s instructions and recommendations for delivery, storage and handling requirements.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify quantities of secured weapons storage cabinets before fabrication. Indicate verified measurements on shop drawings. Coordinate fabrication and delivery to ensure no delay in progress of the work.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating secured weapons storage cabinets without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.

1.10 SEQUENCING AND SCHEDULING

A. Sequence secured weapons storage cabinets with high density mobile storage systems to minimize possibility of damage and soiling during remainder of construction period.

B. Schedule installation of specified secured weapons storage cabinets after finishing operations, including painting, have been completed.

C. Provide components, which must be built in at a time, which causes no delays general progress of the work.

D. Pre-installation Conference: Schedule and conduct conference on project site to review methods and procedures for installing secured weapons storage cabinets.

1. Recommended attendees for pre-installation conference including, but not limited to the following:
    a. Owner's Representative.
    b. Manufacturer's representative.
    c. Subcontractors or installers whose work may affect, or be affected by, the work of this section.

1.11 WARRANTY

A. Provide a written warranty, executed by Contractor, Installer, and Manufacturer, agreeing to repair or replace secured weapons storage cabinets, which fail in materials or workmanship within the established warranty period. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have under General Condition's provisions of the contract documents.

Subject to the conditions stated in the written warranty, Basis of Design, Spacesaver Corporation ("Spacesaver") or equal warrants that the cabinets ("structural frames") manufactured by it will be free from defects in materials and workmanship for the lifetime of the structural frames. For the purposes of this warranty, structural frames shall be deemed to exclude all moving parts (doors, slides, hinges, and lock mechanism), removable accessories, vinyl coating, electronics and refrigeration equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: Products are secured weapons storage cabinets designed to be used either free-standing or with high-density mobile storage systems manufactured by Spacesaver® Corporation.

2.2 BASIC MATERIALS

A. General: Provide materials and quality of workmanship, which meets or exceeds established industry standards for products specified.

2.3 MANUFACTURED COMPONENTS

A. Secure Weapons Storage Cabinets: (4) ROOM AROMRY 115 (All specifications are mandatory)
    1. Cabinet:
        a. The cabinet shall be a one-piece assembly with an outside width of 42.38 inches [1076] millimeters, a useable inside width of 36.5 inches [927] millimeters respectively, an outside height of 61 inches, and an outside depth of 16.25 inches [412] millimeters.

b. The cabinet shall be constructed of 18-gauge [1.2] millimeter double-walled upright posts welded to 18-gauge [1.2] millimeter flat plate steel sidewalls with a diamond mesh perforation.

c. The back wall of the cabinet shall be constructed of 18-gauge [1.2] millimeter steel perforated with diamond mesh and shall be welded to the upright posts.

d. The upright posts shall have interior attachment keyhole slots on [1.5] inch [38] millimeter vertical centers.

e. The top and bottom covers shall be made of 16-gauge [1.5] millimeter steel welded to the upright posts.

f. Cabinet doors shall be heavy-duty 18-gauge [1.2] millimeter, folding and fully retractable in the open position. The cabinet doors shall also include a diamond mesh perforation for visibility as well as rotating locking bars for security.

g. Locking bars shall lock at a single common point.

h. Cabinet construction to have an inherent strength that would prevent an individual from manipulating components (without tools) such that the weapon, receiver, or barrel could be removed.

i. Overall cabinet design such that a weapon, receiver, or barrel cannot be removed by disassembly of the weapon/component and/or the rack without damage to the rack.

j. Hinged locking bars for racks have the hinge pin welded or otherwise secured to prevent disassembly.

k. Finish: shall be factory applied electrostatic powder coat paint

2. Bases:

a. Shall be constructed of 16-gauge [1.5] millimeter steel.

b. Base designs shall be available for supporting a variety of weapon types.

c. Finish:

1) (10) Weapons base design where stock of weapon contacts base shall have a minimum 8mil thick black thermoplastic material finish

3. Support Rails:

a. Support rails shall be constructed of 14-gauge [1.9] millimeter steel and be punched to accept [standard], [extended standard], [wide], [extra wide], [long], [pistol], [standard transport], [large transport], and/or [receiver mounts] barrel supports.

b. Support rails shall contain four (4) rivet heads that interlock with the cabinet interior attachment keyhole slots.

c. Finish: Shall be factory applied electrostatic powder coat paint

4. Back Panel Kit:

a. Back Panel Kit shall be constructed of 14-gauge [1.9] millimeter steel.

b. Back panel hole pattern shall be consistent with universal weapon rack support rails.

c. Back panel shall be compatible with all existing weapon rack designs (excluding mini and [18] inches [457.2] millimeter over storage cabinets), barrel supports, receiver brackets, standard bases, and intermediate shelves.

d. Back Panel must be able to support 700 lbs.

e. Back Panel shall be compatible with existing standard bases and maintain bracket spacing.

f. Back Panel shall be able to co-exist with bin systems and intermediate shelves.

g. Finish: Shall be factory applied electrostatic powder coat paint

5. Barrel Supports:

a. Barrel supports (10) per UWR 1 Unit shall be constructed of 14-gauge [1.9] millimeter steel

b. Finish: Shall have factory applied electrostatic powder coat paint and dipped in black, PVC, [.060-.075] inch [1.52-1.9] millimeter thickness.

6. Bin Storage Systems:

a. Bin storage systems shall be constructed of 18-gauge [1.2] millimeter steel.

b. Bin storage system shall have the ability to create 1/3, 2/3, and full width storage cubicle compartments. The system shall have the flexibility for those compartments to be placed on the left hand, center, and/or right hand positions within the weapon racks usable storage space.

c. Bin storage system shelving shall have flexibility of vertical adjustment on [2.75] inches [69.9] millimeter increments

d. Bin storage system shall be capable of being installed and adjusted easily without the use of fasteners

e. Finish: Shall have factory applied electrostatic powder coat paint

2.4 FIRE RATED GUN SAFE

A. Provided a fire rated 40 minute minimum ammo safe. Basis of Design OR approved equal.

1. Basis of Design: Remington Gun Club SAR5920GC 40-Minute 20 Gun Fire/Waterproof Safe

a. 59"H x 24.5"W x 21"D

2. Winchester Ammo Safe 45min –

a. 60”(H) x 22”(W) x 18”(D)

3. Browning BX14 14 Gun 45-Minute Fire Safe

a. 58” H X 22” W X 20” D SKU:#BX14

2.5 FABRICATION

A. General: Coordinate fabrication and delivery to ensure no delay in progress of the work. All components necessary to complete the arms room installation should come from one manufacturer to ensure proper coordination of installation and no delays in the progress of the work.

2.6 FINISHES

A. Colors: [Selected from manufacturer's standard available colors.]

B. Paint Finish: Provide factory applied electrostatic powder coat paint.

C. Coating: PVC, [.060-.075] inch [1.52-1.9] millimeter thickness.

D. Coating: 8mil thick black thermoplastic material finish

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine storage units scheduled to receive secured weapons storage cabinets with Installer or manufacturer representative present for compliance with requirements for installation tolerances and other conditions affecting performance of specified secured weapons storage cabinets.

B. Verify that intended installation locations of secured weapons storage cabinets will not interfere with or block established required exit paths or similar means of egress once units are installed.

C. Proceed with secured weapons storage cabinet installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Follow manufacturer's written instructions for installation of each type of secured weapons storage cabinets specified.

3.3 FIELD QUALITY CONTROL

A. Verify secured weapons storage cabinet alignment and plumb after installation. Correct if required following manufacturer's instructions.

B. Remove components that are chipped, scratched, or otherwise damaged and which do not match adjoining work. Replace with new matching units, installed as specified and in manner to eliminate evidence of replacement.

3.4 ADJUSTING

A. Adjust all secured weapons storage cabinets to provide smoothly operating, visually acceptable installation.

3.5 CLEANING

A. Immediately upon completion of installation, clean components and surfaces. Remove surplus materials, rubbish and debris resulting from installation upon completion of work and leave areas of installation in neat, clean condition.

3.6 DEMONSTRATION/TRAINING

A. Schedule and conduct demonstration of installed secured weapons storage cabinets and features with Owner's personnel.

B. Schedule and conduct maintenance training with Owner's maintenance personnel. Training session should include lecture and demonstration of all maintenance and repair procedures that end user personnel would normally perform.

3.7 PROTECTION

A. Protect system against damage during remainder of construction period. Advise Owner of additional protection needed to ensure that system will be without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 10 56 13 – METAL STORAGE SHELVING (FOUR-POST SHELVING AND ACCESSORIES)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.

1.2 SUMMARY

A. This Section includes the following:

Four-post type metal shelving.

B. Related Work, Not Furnished:

Finish floor covering materials and installation.

C. Related Sections:

[Sections in Division 9 – Finishes, relating to finish floor and base materials.]

1.3 REFERENCES

A. American National Standards Institute (ANSI) Standards:

Applicable standards for fasteners used for assembly.

B. American Society for Testing and Materials (ASTM) Standards:

Applicable standards for steel sheet materials used for fabrication.

C. American Institute Of Steel Construction (AISC) Standards:

Applicable standards for steel materials used for fabrication.

1.4 DESCRIPTION

A. General: Four-Post Type Metal Shelving.

B. Finishes:

Fabricated Metal Components and Assemblies: All components to be painted with an electrostatically applied Powder Coat paint.

C. Sizes: See Drawings For Shelf Numbers, and Elevations

1. GEAR ROOM 117
2. ARMORY 115

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation instructions for each type of four-post shelving required. Include data substantiating that products to be furnished comply with requirements of the contract documents.

B. Shop Drawings: Show fabrication, assembly, and installation details including descriptions of procedures and diagrams. Show complete extent of four-post shelving installation layout including quantities, locations and types of accessory units required. Include notations and descriptions of all installation items and components.

Show installation details at non-standard conditions, if any.

Provide layout, dimensions, and identification of each unit corresponding to sequence of installation and erection procedures.

Provide installation schedule and complete erection procedures to ensure proper installation.

C. Samples: Provide minimum 3 inch (76MM) square example of each color and texture on actual substrate for each component to remain exposed after installation.

D. Selection Samples: For initial selection of colors and textures, submit manufacturer's color charts consisting of actual product pieces, showing full range of colors and textures available.

E. Warranty: Submit draft copy of proposed warranty for review by the Architect.

F. Maintenance Data: Provide in form suitable for inclusion in maintenance manuals for four-post shelving. Data shall include operating and maintenance instructions, parts inventory listing, purchase source listing, emergency instructions, and similar information.

Submit manufacturer's instructions for proper maintenance materials and procedures.

Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use conditions. Include precautions against using materials and methods, which may be detrimental to finishes and performance.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engage an experienced manufacturer who is ISO 9001 certified for the design, production, installation and service of four-post shelving. Furnish certification attesting ISO 9001 quality system registration.

B. Installer Qualifications: Engage an experienced installer who is a manufacturer's authorized representative for the specified products for installing four-post shelving.

Minimum Qualifications: 1-year experience installing four-post shelving of comparable size and complexity to specified project requirements.

1.7 DELIVERY, STORAGE AND HANDLING

A. Follow manufacturer’s instructions and recommendations for delivery, storage and handling requirements.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify quantities of four-post shelving units before fabrication. Indicate verified measurements on Shop Drawings. Coordinate fabrication and delivery to ensure no delay in progress of the Work.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating four-post shelving units without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.

1.9 [SEQUENCING AND SCHEDULING]

A. Sequence four-post shelving units [with other work] to minimize possibility of damage and soiling during remainder of construction period.

B. Schedule installation of specified four-post shelving after finishing operations; including painting have been completed.

C. Provide components, which must be built in at a time, which causes no delays general progress of the Work.

D. Pre-installation Conference: Schedule and conduct conference on project site to review methods and procedures for installing four-post shelving units including, but not limited to, the following:

Recommended attendees include:

1. Owner's Representative.
2. Prime Contractor or representative.
3. The Architect.
4. Manufacturer's representative.
5. Subcontractors or installers whose work may affect, or be affected by, the work of this section.

1.10 WARRANTY

A. Provide a written warranty, executed by Contractor, Installer, and Manufacturer, agreeing to repair or replace units, which fail in materials or workmanship within the established warranty period. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have under General Conditions provisions of the Contract Documents.

B. Limited Lifetime Warranty for Shelving: Subject to the terms in the written warranty, warrant the original purchaser exclusively that the shelving manufactured by it will be free from defects in materials and workmanship for the lifetime of the shelving.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: Products are based upon four-post shelving manufactured by Spacesaver Corporation.

2.2 BASIC MATERIALS

A. General: Provide materials and quality of workmanship, which meets or exceeds established industry standards for products specified. Use furniture grade sheet metal, wood panels, plastic laminate and fasteners for component fabrication unless indicated otherwise. Material thicknesses/gauges are manufacturer's option unless indicated otherwise.

2.3 MANUFACTURED COMPONENTS

A. Design:

1. Wedge-lock type consisting of uprights, shelves, and shelf supports, designed to be assembled without fasteners or clips. Shelves shall not have any holes on exposed surfaces. Front and back flanges shall be flush with outside faces of posts. Design shall permit individual shelf adjustment and/or removal anywhere along the entire height of uprights.

B. Materials and Workmanship:

1. Fabricate units from Class 1, cold-rolled steel sheet with all bends sharp and true and no exposed "knife" edges.

a. All units shall be free of burrs, sharp edges and projecting hardware with smooth, non-abrasive surfaces and edges.

b. After fabrication, shelving shall exhibit no dents, "oil canning", buckling or other surface irregularities.

C. Uprights: Closed

1. Formed from steel sheet to a hollow "tee" shape for intermediate supports and formed angles for end supports. Uprights shall have keyhole slots on inner wall only. Provide with sheet steel panels full height and depth of end uprights. Provide intermediate "tee" uprights between adjacent units

D. Shelves:

1. Form from sheet steel with flanges on all sides and return hem on front and back flanges. Ends shall be formed to clear inside of upright offset panels. Shelves shall be independently adjustable. Provide all shelves with slots for file dividers.

E. Canopy Tops:

1. Same construction as shelf units.

F. Shelf Supports:

1. Form from heavy gauge steel sheet with four solid steel shoulder rivets, two per ear, that interlock with inner wall of uprights.

G. Nominal Shelf Dimensions: See drawings

1. Shelf Edge Vertical Profile: 3/4 inch (19MM) maximum.
2. Vertical Adjustment Increment: 1-1/2 inches (38MM).
3. Width Of Intermediate Uprights: 2 inches (51MM).
4. Clearance Between Uprights: Nominal shelf section width minus 2 inches (51MM).
5. Number of Vertical Shelf Spaces: As indicated on the drawings
6. Vertical Shelf-To-Shelf Spacing: As indicated on the drawings

H. Load Carrying Capabilities:

1. Provide shelf units capable of supporting 40 pounds per lineal foot (18kg/305MM) with maximum deflection of L/140. Shelves shall exhibit no permanent deflection under fully loaded conditions.

I. Accessories:

1. Full height backs: Provide manufacturer's standard steel back panels noted as "X" on drawings.
2. Bin Dividers: 52.5"H x 24"D, 4 per U5 unit (Gear Room 117)
3. Support Rails: Provide support rails constructed of 14-gauge millimeter steel and interlock with the shelving interior attachment keyhole slots. Supports to be punched to accept heavy duty side supports for pelican cases (2) per U1 unit in Room ARMORY 115

2.4 FABRICATION

A. General: Coordinate fabrication and delivery to ensure no delay in progress of the Work.

2.5 FINISHES

A. Colors: Selected from manufacturer's standard available colors

B. Paint Finish: Provide factory applied electrostatic powder coat paint. Meet or exceed specifications of the American Library Association.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine shelving units scheduled to receive accessories [with Installer present] for compliance with requirements for installation tolerances and other conditions affecting performance of specified accessory items.

B. Verify that intended installation locations of sorter unit units will not interfere with or block established required exit paths or similar means of egress once units are installed.

C. Proceed with accessory installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Follow manufacturer's written instructions for installation of each type of accessory item specified.

3.3 FIELD QUALITY CONTROL

A. Verify accessory unit alignment and plumb after installation. Correct if required following manufacturer's instructions.

B. Remove components that are chipped, scratched, or otherwise damaged and which do not match adjoining work. Replace with new matching units, installed as specified and in manner to eliminate evidence of replacement.

3.4 ADJUSTING

A. Adjust all accessories to provide smoothly operating, visually acceptable installation.

3.5 CLEANING

A. Immediately upon completion of installation, clean components and surfaces. Remove surplus materials, rubbish and debris resulting from installation upon completion of work and leave areas of installation in neat, clean condition.

3.6 DEMONSTRATION/TRAINING

A. Schedule and conduct demonstration of installed accessory items and features with Owner's personnel.

B. Schedule and conduct maintenance training with Owner's maintenance personnel. Training session should include lecture and demonstration of all maintenance and repair procedures that end user personnel would normally perform.

3.7 PROTECTION

A. Protect system against damage during remainder of construction period. Advise Owner of additional protection needed to ensure that system will be without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 11 30 13 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Microwave Cooking appliances.
2. Refrigeration appliances.
3. Electric Range appliances.
4. Dishwasher appliances.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Basis of Design GE or approved equal.

B. Residential Appliance Schedule

1. MO-1 Counter Top Microwave Oven
2. MO-2 Over-Range Microwave Oven
3. RF-1 Refrigerator/Freezer: French door refrigerator with bottom freezer.
4. RF-2 Refrigerator/Freezer: French door refrigerator with bottom freezer and built in ice maker/dispenser
5. RF-3 Undercounter/Compact Refrigerator: Compact
6. DW-1 Dishwasher
7. OR-1 Electric Oven Range. Slide-In Single Oven

C. Sustainable Design Submittals:

1. Product Data: For indicated products, indicating compliance with requirements for ENERGY STAR product labeling.

D. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Field quality-control reports.

C. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 WARRANTY

A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 MICROWAVE OVENS

A. **MO-1** Countertop Microwave Oven

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. General Electric (Basis of Design)
   b. BSH Home Appliances Corporation (Bosch).
   c. Samsung.
   d. Whirlpool Corporation.

2. GE Profile 2.2 Cu. Ft. Countertop Sensor Microwave Oven
3. Model: PES7227SLSS
4. Mounting: Wall cabinet or Countertop
5. Capacity: 2.2 Cu Ft.
6. Microwave Power Rating: 1100 W
7. Power: 120V
8. Material: Stainless Steel
9. Finish: Stainless Steel
10. Locations: Kitchenette Rm 004.1 & Break Rm 209
11. QTY: 2

B. **MO-2** Over-Range Microwave Oven

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. General Electric (Basis of Design)
   b. BSH Home Appliances Corporation (Bosch).
   c. Samsung.
   d. Whirlpool Corporation.

2. GE Profile 1.6 Cu. Ft. Over-the-Range Microwave Oven
3. Model: JVM3160RFS
4. Mounting: Wall cabinet or Countertop
5. Capacity: 2.2 Cu Ft.
6. Microwave Power Rating: 1100 W

7. Power: 120V
8. Material: Stainless Steel
9. Finish: Stainless Steel
10. Locations: Kitchenette Rm 004.1 & Break Rm 209
11. QTY: 2

2.3 REFRIGERATOR/FREEZERS

A. **RF-1** Refrigerator/Freezer: French door refrigerator with bottom freezer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. General Electric (Basis of Design)
   b. BSH Home Appliances Corporation (Bosch).
   c. Samsung.
   d. Whirlpool Corporation.

2. Model: GFE26JYMFS (Basis of Design)
3. Type: Freestanding
4. Storage Capacity: 18.60 cu ft

   a. Refrigeration Compartment Volume: 13.59 cu ft
   b. Freezer Volume: 5.02 cu ft
   c. APPROXIMATE DIMENSIONS (HxDxW) 69 7/8 H x 32 3/4 W x 31 D

5. General Features:
   a. Interior light in refrigeration compartment.
   b. Automatic defrost.
   c. Interior light in freezer compartment.
   d. Automatic icemaker and storage bin.
6. Power: 120V
7. Locations: Control Room 149
8. QTY: 1

9. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
10. Front Panel(s): Stainless steel

B. **RF-2** Refrigerator/Freezer: French door refrigerator with bottom freezer and built in ice maker/dispenser and complying with AHAM HRF-1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. General Electric (Basis of Design)
   b. BSH Home Appliances Corporation (Bosch).
   c. Samsung.
   d. Whirlpool Corporation.

2. Model: GWE19JYLFS (Basis of Design)
3. Type: Freestanding
4. Storage Capacity: 25.70 cu ft

a. Refrigeration Compartment Volume: 17.54 cu ft
b. Freezer Volume: 8.17 cu ft
c. APPROXIMATE DIMENSIONS (HxDxW) 69 7/8 H x 35 3/4 W x 35 7/8 D.

5. General Features:

a. Dispenser in door for ice and cold water
b. Interior light in refrigeration compartment.
c. Automatic defrost.
d. Interior light in freezer compartment.
e. Automatic icemaker and storage bin.

6. Power: 120V
7. Locations: Kitchenette Rm 004.1 & Break Rm 209
8. QTY: 2

9. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
10. Front Panel(s): Stainless steel

C. **RF-3** Undercounter/Compact Refrigerator: Compact.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. General Electric (Basis of Design)
b. BSH Home Appliances Corporation (Bosch).
c. Samsung.
d. Whirlpool Corporation.

2. Model: GCE06GSHSB(Basis of Design)
3. Type: Freestanding
4. Storage Capacity: 5.63 cu ft

a. Refrigeration Compartment Volume: 5.63 cu ft
b. APPROXIMATE DIMENSIONS (HxDxW) 34 1/8 H x 23 5/8 W x 23 3/4 D

5. General Features:
a. Compact internal Freezer
6. Power: 120V

7. Locations: Wellness Rm 111 & Wellness Rm 227
8. QTY: 2

9. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
10. Front Panel(s): Stainless steel

2.4 DISHWASHER

A. **DW-1** Dishwasher Complying with AHAM DW-1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. General Electric (Basis of Design)
b. BSH Home Appliances Corporation (Bosch).
c. Samsung.
d. Whirlpool Corporation.

2. Type: Built-in undercounter
3. Model: GDT226SSLSS
4. Dimensions: (HxDxW) 32 1/4 H x 23 3/4 W x 23 1/2 D
5. ADA Compliant
6. Top Controls
7. Power:
   a. Electrical Requirements 120V ; 60 Hz ; 8.9 A
   b. Power Connection Optional cord kit (GPFCORD - WX09X70910, WX09X70911)
8. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
9. Front Panel: Stainless steel
10. Locations: Break Rm 209
11. QTY: 1

2.5 OVEN RANGE

A. **OR-1** Electric Oven Range. Slide-In Single Oven

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. General Electric (Basis of Design)
   b. BSH Home Appliances Corporation (Bosch).
   c. Samsung.
   d. Whirlpool Corporation.
2. Type: Between Counter
3. Model: GRS500PVSS
4. Dimensions: (HxDxW) 37 1/8 H x 30 W x 28 5/8 D
5. Total capacity: 5.3 cu ft
6. ADA Compliant
7. Front Controls
8. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
9. Power:
   a. Amp Rating at 208V 40
   b. Amp Rating at 240V 40
   c. Bake Wattage 2585W
   d. Broiler Wattage 3410W
   e. KW Rating at 208V 9.1
   f. KW Rating at 240V 12.1
10. Front Panel: Stainless steel
11. Locations: Break Rm 209
12. QTY: 1

PART 3 - EXECUTION

3.1 INSTALLATION

A. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

C. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections

1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After installation, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

B. An appliance will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 11 30 13

SECTION 12 49 40 - ROLLER SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes manual and motorized roller shades.

B. Motorized roller shades linked to Daylight Harvesting.

C. Related Sections include the following:
   1. Section 06100-- Rough Carpentry; blocking for support of window shade brackets or pocket assemblies.
   2. Section 092950-- Substrate for window shade systems and installation of shade pockets, pocket closure, and/ or accessories supplied only under this section.
   3. Section 09513-- Acoustical Ceilings; installations of shade pockets, pocket closure, and/or accessories supplied only under this section.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.

   1. Manual Shade Operators: Include operating instructions and mounting arrangements.

B. LEED Submittals: Comply with Section 01 81 13
   1. MR Credit 4: Material Ingredients
   2. a. Report: Shades, if available

C. hop Drawings: Show location and extent of roller shades. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work. Indicate structural mounting requirements and installation methods as well as relevant dimensions for each product type and mounting condition.

D. Coordination Drawings:
   1. Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
      a. Ceiling suspension system members and attachment to building structure.
      b. Ceiling-mounted or penetrating items including light fixtures, air outlets and inlets, speakers, sprinklers, recessed shades, and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.

c. Shade mounting assembly and attachment.
d. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).

2. Provide shade schedule coordinating room number, opening size(s), quantities and key to details.

E. Samples for Initial Selection: For each colored component of each type of shade indicated.

1. Include similar Samples of accessories involving color selection.

F. Samples for Verification:

1. Complete, full-size operating unit not less than 16 inches (400 mm) wide for each type of roller shade indicated.
2. For the following products:

a. Material samples for initial color & finish selection of controls and full range of fabrics available.

b. Shade Material: Not less than 8” x 10” (200mm x 252mm) for specific color samples requested by Architect. Mark face of material.

G. Window Treatment Schedule: For roller shades. Use same designations indicated on Drawings.

H. Product Certificates: For each type of roller shade, signed by product manufacturer.

I. Qualification Data: For Installer.

J. Product Test Reports: For each type of roller shade based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency for each type of roller shade.

K. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:

1. Methods for maintaining roller shades and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
3. Operating hardware.

L. Manufacturer’s Instructions.
1. Installation, Programming, and Maintenance instructions to be included in product packaging.
2. Installation, Programming, and Maintenance instructions to be included on Manufacturer’s website
3. 24-Hour / 7 Day Technical support shall be available to aid with unforeseen installation difficulties.

M. LEED Submittals: Comply with Section 018113.

1. MR Credit 4: Material Ingredients

a. Report: Shades, if available

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Source Limitations: Obtain roller shades through one source from a single manufacturer.

C. Installer shall be qualified to install the specified products by prior experience, demonstrated performance and acceptance of any requirement of the manufacturer, subsidiary of the manufacturer, or licensed agent.

D. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Resistance Ratings: Passes NFPA 701.

E. Product Standard: Provide roller shades complying with WCMA A 100.1.

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory packages, marked with manufacturer and product name and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Rollers Shades: Before installation begins, for each size, color, texture, and pattern indicated, full-size units equal to 5 percent of amount installed.

1.8 WARRANTY

A. Manufacturer to provide written limited warranty of not less than 8 years non-depreciating.

1. Warranty coverage shall begin on the date that the equipment is energized.

2. In the event of a warranted product failure, the shade contractor will facilitate acquisition and delivery of all necessary components and services to the owner.

PART 2 - PRODUCTS

2.1 ROLLER SHADES

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:
1. MechoShade Systems, Inc. Basis of Design
2. RollEase Inc. 200 Harvard Ave.; Stamford, CT 06902-6320; Toll Free Tel: 800-552-5100
3. Draper Inc.
4. Hunter Douglas, Inc.; Hunter Douglas Window Fashions Division
5. Levolor; Levolor-Kirsch Window Fashions; a Newell Rubbermaid Company
6. Lutron Shading Solutions by VIMCO,
7. Somfy Electric

C. RS-1: 25 percent Polyester, 75 percent Vinyl on Polyester.
1. Collection: ThermoVeil
2. Series: 1500 Dense Basket Weave (5% open/Tv 5%)
3. Color: TBD
4. Hardware: **Manual**
Location: All other locations

D. RS-2: 24 percent Polyester, 76 percent Vinyl on Polyester.
1. Manufacturer: Mecho
2. Collection: DoubleShades
3. Series: 0100 Equinox Blackout
4. ThermoVeil 5%
5. Color: TBD
6. Hardware: **Mechanized**
7. Location: See RCPs, Conference Rooms, Community Rm & Rooms:
8. Electrical: Wire to lock down switch in security system. **Coordinate with OIT.**

2.2 MANUAL ROLLER SHADES

A. Metal Pocket Enclosure

1. General
   a. Full metal pocket enclosure housing with removable closure fascia.
      1) Mecho Shade Pocket size = (5-3/8"w x 5"h).
      2) Lutron Pocket size = (4-3/4"w x 5"h).
      3) full metal pocket enclosure housing with removable closure fascia.

B. Clutch Brake Manual Shade System
   1. General
      a. Basis of Design: MechoShade Systems, Inc. clutch brake system.
      b. Clutch Roller Shades shall be a ball chain-operated system utilizing a bidirectional wrap spring clutch.
      c. The system must be capable of smoothly raising and lowering the shade to any desired height and maintaining that position without slippage.
      d. The shade cannot be operable by any other means other than the chain. Pulling on the hem bar will not disengage the clutch.
      e. The system will provide a maximum fabric gap of 0.75” per side.

   2. Clutch and Tube Specifications
      a. System shall incorporate a bi-directional wrap spring clutch and never require any adjustment of the shade.
      b. Shade shall stop upon release of clutch. Systems that slide to a stop are not acceptable.
      c. Clutch may be mounted on either the right or left end of the roller tube and fabric may be forward or reverse rolled.
      d. The clutch shall be made of high-strength fiberglass reinforced polyester with high carbon steel springs.
      e. Manufacturer shall identify appropriate shade tube and clutch size based on shade size, fabric type, and application requirements.
         1) Shades using a V8 Clutch can lift up to 8 lbs of fabric using a 1” diameter, .03” enameled, roll-formed steel tube.
         2) Shades using a V16 clutch will be used with a 1.375” or 1.75” diameter, .03” enameled, roll-formed steel tube or a 2” diameter, 0.62” extruded aluminum tube. The appropriate tube will be used to prevent excessive deflection along its length.
         3) Shades using a V24 clutch will be used with a 1.375” or 1.75” diameter, .03” enameled, roll-formed steel tube or a 2” or 2.5” diameter, 0.62” extruded aluminum tube. The appropriate tube will be used to prevent excessive deflection along its length.
      f. Fabric shall be connected to tube with double-sided adhesive strip applied for exact and firm mounting of the fabric and for easy adjustment of fabric to prevent telescoping.
         1) A minimum of one turn of fabric will be placed on the roller before the working section of fabric starts to protect the fabric and smooth out the starting seam.

   3. Clutch Control Loop
      a. Chain will be made of #10 stainless steel 90-pound test ball chain.
      b. Chain will be provided with connector and upper and lower ball stops.

   4. Clutch Idle End Cap
      a. Two-piece unit consisting of an outside sleeve and center bearing shaft made of high-strength fiberglass reinforced polyester.

1) The outside sleeve shall be free to rotate on the shaft, providing the bearing surfaces on which the roller rides in order to provide a smooth and quiet rotation without wearing on the system.

5. Clutch Mounting Brackets
   a. Shall be .072" galvanized steel
   b. Shall be universally applicable for mounting inside, outside or to the ceiling, with the clutch on either the right or left side of the roller.
   c. The clutch mounts flush to the face of the bracket resulting in the smallest possible light gap between fabric and window frame.

6. Lift Assist Spring
   a. General
      1) Depending upon shade weight and size, manufacturer may require a lift assist spring to prevent excessive deflection along the length of the tube.
      2) Spring shall be a torsion roller spring with a polymer injection molded tube fitting and ball bearing stops used to maintain shade position.
   b. Lift Assist Spring Mounting Brackets
      1) Shall be .060" galvanized steel.
      2) Shall be universally applicable for mounting inside, outside or to the ceiling.
      3) Shall have a locking device that provides safe retention of the spring end in its bracket.
   c. Lift Assist Spring Idle End Cap
      1) Shall be a polymer injection molded insert.
      2) Shall have a protruding galvanized steel roller pin that engages the bracket.

C. Direction of Roll: Regular, from back of roller.

D. Fascia: Shall be installed to conceal the roller tube and mounting hardware. Fascia shall hook onto the top of the bracket and snap in place, remaining firmly attached. Four inch high fascia panel shall be made of .075” extruded aluminum and shall be painted with a high quality baked enamel finish. Brackets are designed to snap into the Top/Back Cover.

E. Top/Back Cover: Shall be .085” extruded aluminum with baked enamel finish that fits over fascia brackets and completely covers the top and back sides of the roller shade. 4” Top / Back cover has a channel, which allows the fascia interlock.

F. Bottom Bar: Standard Hem Bar shall be a 1” wide by .1875” thick extruded aluminum bar enclosed in a thermally-sealed pocket across the bottom of the shading fabric.

G. Mounting: Inside, unless otherwise noted on the window treatment schedule, mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

H. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard for anchoring roller shade bottom in place and keeping shade band material taut.

I. Shade Operation: Manual; with continuous-loop bead-chain, clutch, and cord tensioner and bracket lift operator.
   1. Position of Clutch Operator: Right side of roller, as determined by hand of user facing shade from inside, unless otherwise indicated on Drawings or in a window treatment schedule.
   2. Clutch: Capacity to lift size and weight of shade; sized to fit roller or provide adaptor.

3. Lift-Assist Mechanism: Manufacturer's standard spring assist for balancing roller shade weight and lifting heavy roller shades.
4. Loop Length: Length required to make operation convenient from floor level
5. Bead Chain: #10 Stainless steel 90-pound test ball chain.
6. Cord Tensioner Mounting: As indicated on the window treatment schedule.
7. Operating Function: Stop and hold shade at any position in ascending or descending travel.

2.3 MOTORIZED ROLLER SHADES

A. Description: Electrically operated motorized roller screen window shading system.
B. Standard Bracket/Pocket: Extruded aluminum (smooth) pocket to be recessed into drywall bulk-head with pocket closure with baked enamel finish.

1. QS Roller Shade with full metal pocket enclosure housing with removable closure fascia. Pocket size = (4-3/4"w x 5"h). By Lutron or approved equal.
2. ElectroShade II with SnapLoc Fascia (full metal pocket enclosure housing with removable closure fascia). Pocket size = (5-3/8"w x 5"h). By Mecho Shade or approved equal.

C. Motor:

1. Shall be tubular asynchronous and concealed inside an extruded aluminum tube.
2. Roller shades with 24-volt AC microprocessor intelligent motor system.
3. The electronic drive unit to operate without exceeding a 44dBA (SPL) measured 3 feet from motor.
4. System to make no audible clicks when motor starts or stops.
5. System controls to have a 10-year power failure memory for preset positions, open and cloe limits, shade grouping and system configuration.
6. Electronic Drive Unit will position the shade fabric to 1/16” of preset positions.

D. Control System: Manufacturers standard system customized to project requirements as follows:

1. Shades shall be zoned in groups for each room.
2. Power Panel equivalent to Lutron SVQ10PNL or equal. Provide 1 per every 10 shades.
3. One low voltage switch per room with low voltage momentary contacts.
4. Motor controller shall have low voltage control port for AV control system contact closure to operate in parallel with low voltage wall switch.
5. Shades shall be tied back to the Smart Lectern in each space. Shade controls from touch screen at smart lectern shall include the following: Open/Close and Raise/Lower.
6. Shades shall be coordinated to operate the Daylight Harvesting controls.
7. Control system shall integrate with Crestron or Lutron control systems.

E. Locations: 201 Conference Room, 301 Conference Room, 362 Training Room

2.4 ROLLER SHADE FABRICATION

A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.

B. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Lifting Mechanism: With permanently lubricated moving parts.

C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):

1. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch (6 mm) from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
2. Shade Units Installed Outside Jambs: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting fascia, roller, and operating hardware and for hardware position and shade mounting method indicated.

E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

F. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

G. Colors of Metal and Plastic Components Exposed to View: As selected by Architect from manufacturer's full range unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow clearances for window operation hardware.

B. Connections: Connect motorized operators to building electrical system.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain roller shades. Refer to Division 1 Section Demonstration and Training."

END OF SECTION 12 49 40

SECTION 12 55 00

DETENTION FURNITURE AND ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

A. ASTM INTERNATIONAL (ASTM) ASTM A36/A36M (2019) Standard Specification for Carbon Structural Steel

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations indicated on Drawings in product schedule.

D. Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

SD-02 Shop Drawings

BNK-1	Fixed detention grade bunk frame
CB-1	Fixed stainless-steel bench with cuff bars
CR-1	Stainless Steel Handcuff Ring
DBN	Detention-grade ADA Shower Seats
DGB	Security Grab Bars - Anti-ligature, 18”, 36”, & 42”
SD-2	Detention-grade recessed self
TP-2	Toilet Paper Holder Anti-ligature (wall recessed)
FPM	Figure Printing Machine (Not required, salvaged GC to see salvage list)
DMR	ADA Wall Mount Mirrors
DWH	Anti-ligature Towel hook
MD-90	18” Mirror Quarter Dome, convex mirror
MD-180	18” Mirror Half Dome, convex mirror

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver furniture and accessories in packaging to provide protection during transit and job storage. Leave in unopened original containers, clearly labeled for location of installation.

1.4 QUALITY ASSURANCE

A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.

1.5 COORDINATION

A. See TA Sechedule on drawings.
B. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by General Contractor under requirements of the Contract Documents.

B. Manufacturer's Warranty:

1. Minimum Warranty Period: 2 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 SECURITY GRAB BARS ANTI-LIGATURE – DBG
a. Provide as specified in Section 10 28 13 TOILET ACCESSORIES, and in lengths and configurations indicated.
b. Provide for Security Grab Bars with safety gap-filler between the round tube bar and the wall. These are to be stainless steel, and provided with anti-tamper screws
c. Straight - see toilet accessory schedule for size
d. L-Shape.
e. Basis of Design models: IGS-18-3, IGS-36-3, IGS-42-3
i. Or approved equal.

2.2 NOT USED

2.3 FIXED DETENTION GRADE BUNK FRAME & MATTRESS - BNK-1
a. Universal formed 18 gauge steel pan with factory applied polyester powder coat finish.
b. Size: 27” x 80”
c. Floor mounted with bolting to floor.
d. Basis of Design: Norix B510-160, or approved equal.
e. Mattress:
1 Inverted RF welded sealed seam with polyurethane coated polyester
2 Size: 27” x 74” x 4.5”
3 Without integrated pillow.
4 Color: to be selected from standard color line by architect.
5 Warranty: Five year warranty prorated seam and cracking.\

2.4 DETENTION GRADE SHOWER SEAT – DBN

a. Provide stainless steel detention-grade recessed shower seat, that meets ADA 4.21.3 & 4.26.3 requirements for L-shaped shower seats. Provide with straps. Provide for folding seat assembly attaches to wall mount assembly using tamper resistant hardware. Cut, formed and welded steel and stainless steel frame to fit wall opening, with 1/2" diameter solid stainless steel hinge. Made in the U.S.A.
b. Size: 36.3” x 25.9” x 25.9”
c. Warranty: 1 year limited replacement warranty plus a one year extended warranty.
d. Basis of Design: Norix ISS-200, or approved equal.

2.5 DETENTION GRADE BENCH WITH CUFF RINGS – CB-1

a. Cut, formed and welded steel. Cuff rings welded to frame. 12 gauge steel seating surface with 1/8" wall legs or 7 gauge (.180") brackets and 3/8" dia. steel cuff rings with powder coat finish. Made in the U.S.A.
b. Sizes: CB-1 48”L x 18”D x 18”H, CB-2 24”L x 18”D x 18”H
c. Warranty: 1 year limited replacement warranty plus a one year extended warranty.
d. Basis of Design: Norix IBF-48 or approved equal.

2.6 STAINLESS STEEL CUFF RING – CR-1

a. 3/8” stainless rod welded to 12 gauge 6”x6” stainless steel mounting plate
b. 4 -- ½” predrilled mounting holes
c. Basis of Design: KryptoMax KM-WHCR
d. Provide from same manufacture, ½” tamper resistant concrete anchors – KM-BHA-1/2x31/4-Z
e. Coordinate with owner and architect for final mounting location.

2.7 DETENTION GRADE RECESSED SHELF – SD-2

a. Formed and welded 16 gauge type 304 stainless steel. Exposed surfaces polished to #4 finish. Brushed stainless steel frame and satin interior. Made in the U.S.A.
b. Sizes:
    1 Opening Height 5”
    2 Opening Width 16”
c. Warranty: 1 year limited replacement warranty plus a one year extended warranty.
d. Basis of Design: Norix S565-550 or approved equal.

2.8 DETENTION GRADE RECESSED TOILET PAPER SHELF ANTI-LIGATURE (WALL RECESSED) – TP-2

a. Recessed toilet paper holder made of stainless steel.
b. Mounted with anti-tamper screws.
c. To be anti-ligature and tamper resistant, having been fully welded with no loose parts
d. Warranty: 1 year limited replacement warranty plus a one year extended warranty.
e. Basis of Design: ITP-110

2.9 DETENTION GRADE MIRROR – DMR

a. Mirror shall be #430 stainless steel, highly polished #8 finish with steel backer plate.
b. Frameless, wall mounted with anti-tamper screws.
c. Provide for ADA wall Mirror: 11.3” x32”
d. Warranty: 1 year limited replacement warranty plus a one year extended warranty.
e. Basis of Design: Norix R565 Ironman Inmate Cell Wall Mirror.
    i. Or Approved Equal.

2.10 DETENTION GRADE TOWEL HOOK – DWH

a. Backplate: One piece formed and ground smooth 14 gauge type 304 stainless steel. Safety Hook: Fabricated from cast & machined stainless steel with stainless steel ball and spring. Brushed stainless steel finish.
b. Dimensions:
    1 Height: 5.5”
    2 Width: 18”
    3 Depth 1.3”
c. Warranty: 1 year limited replacement warranty plus a one year extended warranty.
d. Basis of Design: Norix ITS-410, or approved equal.

2.11 DETENTION GRADE DOME MIRRORS – MD-90 & MD-180

a. GC shall coordinate final locations with owner and user to give preference to views in space and to avoid conflicts with CCTV locations.
b. MD-90:
    1 Mirror: 1/8" polycarbonate with a pure silver reflective coating on inside surface. Fully enclosed foam insert fills cavity to reduce flexing and enhance strength. 90o view. Frame: 3/16 x 1" steel has recessed holes for fastening and slotted flange for mirror. Powder coated to provide durable smooth finish.
    2 Dimensions:
        a Length: 27”
        b Height: 9”
        c Depth: 19”

c. MD-180
    1 Mirror: 1/8" polycarbonate with a pure silver reflective coating on inside surface. Fully enclosed foam insert fills cavity to reduce flexing and enhance strength. 180o view. Frame: 3/16 x 1" steel has recessed holes for fastening to any solid flat surface. Powder coated to provide durable smooth finish.
    2 Dimensions:
        a Length: 20”
        b Height: 10”
        c Depth: 5.5”
d. Warranty: 3 year limited replacement warranty
e. Basis of Design: Norix MQD-N18 & MHD-18 or approved equal.

2.12 MANUFACTURERS

a. Norix, Basis of Design
b. Cortech USA
c. Britex
d. Brey Krause
e. Kryptomax
f. Or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

C. Install grab bars to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

SECTION 14 21 23.16 - MACHINE ROOM-LESS ELECTRIC TRACTION PASSENGER ELEVATORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
B. Baltimore County Property Management's general requirements included in each bid package shall also apply to this Section. In case of conflict the more stringent document shall take precedence.
C. Section includes Machine room-less electric traction passenger elevators as shown and specified. Elevator work includes:
    1. Gearless electric traction passenger elevators.
    2. Elevator car enclosures, hoistway entrances and signal equipment.
    3. Operation and control systems.
    4. Accessibility provisions for physically disabled persons.
    5. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
    6. Materials and accessories as required to complete the elevator installation.

1.02 SUMMARY

Related Sections:

A. Division 1 General Requirements: Meet or exceed all referenced sustainability requirements.
B. Division 3 Concrete: Installing inserts, sleeves and anchors in concrete.
C. Division 4 Masonry: Installing inserts, sleeves and anchors in masonry.
D. Division 5 Metals:
    1. Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
    2. Providing steel angle sill supports and grouting hoistway entrance sills and frames.
E. Division 9 Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.
F. Division 16 Sections:
    1. Providing electrical service to elevators, including fused disconnect switches where permitted. (Note: fused disconnect switch to be provided as part of elevator manufacture product)
    2. Emergency power supply, transfer switch and auxiliary contacts.
    3. Heat and smoke sensing devices.
    4. Convenience outlets and illumination in control room (if applicable), hoistway and pit.
G. Division 22 Plumbing
    1. Sump pit
H. Division 23 Heating, Ventilation and Air Conditioning
    1. Heating and ventilating hoistways and/or control room.

I. Work Not Included: General contractor shall provide the following in accordance with the requirements of the Model Building Code and ASME A17.1 Code. For specific rules, refer to

ASME A17.1, Part 2 for traction elevators. State or local requirements must be used if more stringent. The cost of this work is not included in the Elevator provider's proposal since it is a part of the building construction.

1. A plumb and legal hoistway, properly framed and enclosed an including a pit of proper depth, and a pit ladder for each elevator. Hoistway walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2" at any point. Drains, lights, access doors, waterproofing and hoistway ventilation, as required.
2. Elevator controller space
    a. Door jamb controller option - controller landing wall thickness must be a minimum of 8 1/2 inches thick. This is due to the controller being mounted on the top floor landing in the door frame on the return side of the door. For center opening doors, the controller is located on the right hand frame (from inside the elevator cab looking out). Provide telephone line, light fixture (200 lx / 19 fc), and convenience outlet in the hoistway at the landing where the elevator controller is located. Final location must be coordinated with elevator contractor. These requirements must be coordinated between the general contractor and the elevator contractor.
    b. Control room option - provide a suitable control closet with access and ventilation in accordance with all applicable codes and regulations. The control closet shall be maintained at a temperature between 32 F (0 C) and 104 F (40 C). To be measured at 6 feet (1830 mm) above the floor and 1 foot (305 mm) out from the front center of the car controller(s). Relative humidity is not to exceed 95% non-condensing. Local codes may require tighter temperature ranges, and higher ventilation levels, please check with your local code authority for the exact requirements in your area. If your control closet temperatures exceed these requirements, contact your local Elevator providers sales representative for assistance. All telephone wiring to controller room control panel, and installation of telephone instrument or other communication equipment in elevator cab with all connections to elevator in controller room.
3. Hoistway must be maintained between 32ºF (0ºC) and 122ºF (50ºC) measured at the machine.
4. Adequate supports to carry the loads of all equipment, including overhead machine and machine beams located in hoistway including supports for guide rail brackets.
5. Complete 3 phase connections from the electric power mains to each controller, including necessary circuit breakers and fused mainline disconnect switches unless otherwise specified herein by elevator manufacture.
6. Electric power of the same characteristics as the permanent supply without charge for the construction, testing and adjusting.
7. Provide proper piping and conduit.
8. Divider beams for rail bracket support as required.
9. Cutting of walls floor, etc. and removal of such obstructions as may be necessary for proper installation of the elevator.
10. Grouting of door sills, hoistway frames, and signal fixtures after installation of the elevator equipment.
11. All painting, except as otherwise specified.
12. Provide hoistway walls designed and constructed in accordance with the required fire rating (including those places where elevator fixture boxes, rail bracket fastenings, and any other penetration into the hoistway walls).

13. Temporary enclosures, barricades and other protection from open hoistways and elevator work area during the time the elevator is being installed to meet all permanent installation safety codes. A temporary work platform to be provided at the top landing across the hoistway; if required, it should conform to all code and safety requirements.
14. Smoke detector /sensing devices and contacts wired to elevator control as required by local code. A means to automatically disconnect the main line power supply to the elevator prior to the application of water in the elevator controller room shall be furnished by the electrical contractor. This means shall not be self-resetting.
15. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.
16. A standby power source, including necessary transfer switches and auxiliary contact, where elevator operation from an alternate power supply is required.
17. Adequate storage facilities for elevator equipment prior to and during installation at ground level within 150 feet of hoistway.
18. Setting of anchors and sleeves.
19. Install bevel guards at 75° on all recesses, projections or setbacks over 2" (4" for A17.1 2000 areas) except for loading or unloading.
20. For car light and fan: provide a feeder and branch wiring circuits to elevator control cabinet.
21. Locate a light fixture (200 lx / 19 fc) and convenience outlet in pit with switch located adjacent to the access door.
22. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42" minimum, (48" minimum for A17.1-2019 areas) shall be provided at the same height, above sill of access door or handgrips.

1.03 SUBMITTALS

A. Product data: When requested, the elevator contractor shall provide standard cab, entrance and signal fixture data to describe product for approval.

B. Shop drawings:
   1. Show equipment arrangement in the corridor, pit, and hoistway and/or optional control room. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
   2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
   3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
   4. Indicate electrical power requirements and branch circuit protection device recommendations.

C. Paint selection: Submit manufacturer’s standard selection charts for exposed finishes and materials.

D. Integrated laminate selection: Submit manufacturer’s standard selection charts for exposed finishes and materials.

E. Metal Finishes: Upon request, standard metal samples provided.

F. Operation and maintenance data. Include the following:
   1. Generic owner's manuals and no wiring diagrams.
   2. Parts list, with recommended parts inventory.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: An approved manufacturer with minimum 15 years of experience in manufacturing, installing, and servicing elevators of the type required for the project.
   1. The manufacturer of machines, controllers, signal fixtures, door operators, cabs, entrances, and all other major parts of elevator operating equipment.
      a. The major parts of the elevator equipment shall be manufactured by the installing company, and not be an assembled system.
   2. The manufacturer shall have a documented, on-going quality assurance program.
   3. ISO-9001:2000 Manufacturer Certified
   4. ISO-14001:2004 Environmental Management System Certified
   5. LEED Gold certified elevator manufacturing facility.

B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than 15 years of satisfactory experience installing elevators equal in character and performance to the project elevators.

C. Regulatory Requirements:
   a. ASME A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.
   b. NFPA 70 National Electrical Code.
   c. NFPA 80 Fire Doors and Windows.
   d. Americans with Disabilities Act - Accessibility Guidelines (ADAAG)
   e. Section 407 in ICC A117.1, when required by local authorities
   f. CAN/CSA C22.1 Canadian Electrical Code
   g. CAN/CSA B44 Safety Code for Elevators and Escalators.

D. Fire-rated entrance assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10(b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).

E. Inspection and testing:
   a. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
   b. Arrange for inspections and make required tests.
   c. Deliver to the Owner upon completion and acceptance of elevator work.

F. Sustainable Product Qualifications:
   a. Environmental Product Declaration:

(1) GOOD: If Product Category Rules (PCR) are not available, produce a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that has at least a cradle to gate scope.
(2) BEST: If Product Category Rules (PCR) are available, produce and publish an Environmental Product Declaration (EPD) based on a critically reviewed life-cycle assessment conforming to ISO 14044, with external verification recognized by the EPD program operator.

b. Material Transparency:
(1) GOOD: Provide Health Product Declaration at any level
(2) BETTER: Provide Health Product Declaration (HPD v2 or later). Complete, published declaration with full disclosure of known hazards, prepared using the Health Product Declaration Collaborative's "HPD builder" on-line tool.
(3) BEST: Cradle to Cradle Material Health Certificate v3, Bronze level or higher.

c. LEED v4 – Provide documentation for all Building Product Disclosure AND Optimization credits in LEED v4 for product specified.

1.05 DELIVERY, STORAGE AND HANDLING

A. Manufacturing shall deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.

1.06 PROJECT CONDITIONS

A. Temporary Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement.

1.07 WARRANTY

A. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 24 months after final acceptance.

1.08 MAINTENANCE

A. Furnish maintenance and call back service for a period of 12 months for each elevator after completion of installation or acceptance thereof by beneficial use, whichever is earlier, during normal working hours excluding callbacks.
1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.
2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.
3. Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer: Basis of Design TK Elevator’s EOX Self-Supported Machine Room-Less elevator, or approved equal with dimensional and all other requirements coordinated by the GC.

2.02 MATERIALS, GENERAL

A. All Elevator Cab materials including frame, buttons, lighting, wall and ceiling assembly, laminates and carpet shall have an EPD and an HPD.

B. Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.

C. Steel:
1. Shapes and bars: Carbon.
2. Sheet: Cold- and hot-rolled stainless steel sheet, galvanized.
3. Finish: Factory-applied paint for structural parts, painted for architectural parts. Color selection must be based on elevator manufacture’s standard selections.

D. Integrated laminate: Decorative surface finishes, pressure sensitive, acrylic type, nominal 0.014" thickness. Laminate selection must be based on elevator manufacture’s standard selections.

E. Flooring by others.

2.03 HOISTWAY EQUIPMENT

A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and riveted/clinched. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.

B. Deflector Sheaves: None

C. Guide Rails: Dry, non-lubricated steel, fastened to the building with steel brackets.

D. Guides: Slide guides shall be mounted on top and bottom of the car.

E. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Predefined buffer stands for 4’ and 5’ pit depths.

F. Machine: The hoisting machine shall be a compact energy efficient permanent magnet Gearless traction type, consisting of PMAC motor, brake and driving sheave mounted on a rigid bedplate in the top of the hoistway. A large solid, forged shaft shall serve as a support for the motor rotor assembly and for the drive sheave and brake system. It shall be supported by roller bearings mounted in the machine housing.

G. Drive System:
   1. The drive system shall be of the Variable Voltage Variable Frequency (VVVF) regenerative.
   2. The system shall be a vector controlled pulse-width modulated AC drive. The variable voltage variable frequency drive shall convert the AC power supply using a two-step process to a variable voltage variable frequency power supply for use by the hoist motor.
   3. The speed control shall be by means of vector control providing direct torque and field excitation automatically provided by permanent magnet. A digital absolute velocity encoder shall be provided giving feedback to the controller on armature position and motor speed.
   4. Dual solid state electronics (IGBT Insulated Gate Bipolar Transistor) in series shall be used in place of mechanical contactors.

H. Motor/Machine: The motor shall be PMAC, totally enclosed, non-ventilated with class "F" insulation. The motor armature shall be dynamically balanced and supported by roller bearings of ample capacity. The armature and driving sheave shall be properly balanced for smooth, high-speed elevator performance. The PM machine shall be mounted horizontally in the top of the hoistway in a unitized formed steel structure on bearing plates furnished by the elevator installer. The unitized formed steel structure shall be securely fastened to the supports supplied by other trades.

I. Brake: The brake shall be a spring applied electric brake; held open by an electro-magnet actuated by a digital brake controller and designed to make smooth, positive stops. The Brake shall be designed to automatically apply in the event of interruption of power supply from any cause. Operation and control of the brake shall be all digital. The setting and lifting of the brake shall be software based and all electronic. All adjustments and setup of the brake shall be made using a PC interface. No contactors or resistors shall be used in the actuation of the brake.

J. Suspension Belts and Governor Rope: Suspension belts shall be flat belts of polyurethane with an inner core of 14 steel cords with an FT1 fire rating such that hoistway sprinklers are not required by NFPA-13. Each belt shall have a suspension strength of 64 KN (14,388 pounds).
   1. Three belts.
   2. Suspension tension monitor shall detect differences in belt tension and for loss of tension. If fault is detected, the car shall stop at the nearest floor and an Out of Service call be registered.
   3. Trip criteria shall be monitored, and data shall be stored in redundant non-volatile locations. Belts shall be replaced prior to the end of service life. Messages shall be issued at 180, 90, and 30 days prior to the last day of service life.
   4. Governor ropes shall be of steel wire construction.
   5. Any special tools, devices, software or equipment required for monitoring the wear of suspension shall be included with the installation of the equipment and become the property of the owner at time of elevator completion. This includes special ongoing monitoring systems, special tools and instruction needed to monitor the suspension system.

K. Counterweight: Counterbalance each elevator for smooth and economical operation by using steel and/or cement weights securely fastened in a steel counterweight frame. Counterweight

shall equal the weight of the complete elevator car and approximately 50 percent of the specified capacity load.

L. Safety and Governor: Car safety shall be mounted on the bottom members of the car frame and be operated by a centrifugal speed governor. The governor shall be designed to cut off power to the motor and apply the brake whenever the governor indicates the car has excessive speed. The governor shall function when the car over speeds.

M. Emergency Terminal Limits: Place electric limit devices in the hoistway near the terminal landings. Limit switch(es) shall be designed to cut off the electric current and stop the car if it runs beyond either terminal landing.

N. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.

2.04 HOISTWAY ENTRANCES

A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.
1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates (where required), sight guards, and necessary hardware.
2. Communication failure indicator: A Communication failure is a jewel that is located in the jamb and lights up if the connection with the phone in the elevator becomes faulty. Communication failure is tested on the SIL3 rated devices by inspectors to ensure the car will not run or accept a car call when there is a loss of communication between the car and controller.
3. Main landing door & frame finish: with no. 4 brushed finish entrance frame.
4. Typical door & frame finish: with no. 4 brushed finish entrance frame.

B. Interlocks: Equip each hoistway entrance with an approved type of interlock, tested as required by code. Provide door restriction devices as required by code.

C. Door Hanger and Tracks: Provide sheave type two-point suspension hangers and tracks for each hoistway horizontal sliding door.
1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
2. Hangers: Provide an adjustable device beneath the track to limit the up thrust of the doors during operation.
3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.

D. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.

2.05 PASSENGER ELEVATOR CAR ENCLOSURE

A. Car Enclosure:

1. Walls: Cab type, stainless steel. Wall panels shall be constructed of stainless steel, no 4 brushed finish. Columns shall be stainless steel.
2. Canopy: Galvanized steel with chain rope exit.
3. Ceiling: Stainless steel downlight type, metal pans with suspended LED downlights. Number of downlights shall be dependent on platform size with a minimum of four. The metal pans shall be finished with a stainless steel, no. 4 brushed finish.
4. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with brushed stainless steel.
5. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
    a. Door Finish: Stainless steel.
    b. Cab Sills: Extruded, aluminum mill finish.
6. Support rail: Provide 1.5" (38 mm) diameter formed cylindrical metal bar on side and/or rear walls on front opening cars and side walls only on front and rear opening cars. Support rails shall have a stainless steel, no. 4 brushed finish.
7. Ventilation: Manufacturer’s standard exhaust fan, mounted on the car top.
8. Protection pads: Not required

B. Car Top Inspection: Provide a car top inspection station with an “Auto-Inspection” switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station shall give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.06 DOOR OPERATION

A. Door Operation: Provide a direct or alternating current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. The mechanical door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. AC controlled units with oil checks, or other deviations are not acceptable.
    1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
    2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
    3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the

door closes to within 6 inches of fully closed, the travel shall reverse and the door shall reopen to answer the other call.

4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer shall sound. When the obstruction is removed, the door shall begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors shall stop and resume closing only after the obstruction has been removed.
5. Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors shall reverse and reopen. After the obstruction is cleared, the doors shall begin to close.
6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors shall recycle closed then attempt to open six times to try and correct the fault.
7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors shall recycle open then attempt to close six times to try and correct the fault.
8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

B. Door Protection Device: Provide a door protection system using microprocessor controlled infra-red light beams supporting 2D or 3D light curtains per code. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.07 CAR OPERATING STATION

A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in a surface-mounted panel requiring no applied faceplate. COP shall have a brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED’s shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided. Visual highlight is the standard equipped, integrated multimedia display.

B. Emergency Communications System: Integral phone system provided. For improved accessibility, there are visual and acoustic confirmation for button inputs as well as a voice synthesizer for travel and floor announcements.

C. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate, and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.

D.

D. Special Equipment: Not Applicable

E.

E. Digital Services: Cloud-based IoT monitoring system comes standard with these options:

Remote Monitoring with Application Programming Interface (API) Integration

ADA Phone – Code Compliant Cellular Connectivity

F. Digitally Native: Digital expansion for evolving ecosystem of digitally augmented services. DEP infotainment display comes standard.

2.08 CONTROL SYSTEMS

A.

Controller: The elevator control system shall be microprocessor based and software oriented. The system shall operate in real time, continuously analyzing the car(s) changing position, condition, and work load. All controller and operational circuits including the brake control and drive system shall be digital. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.

1. Momentary pressing of one or more buttons shall dispatch the car to the designated landings in the order in which the landings are reached by the car, irrespective of the sequence in which the buttons are pressed. Each landing call shall be canceled when answered.
2. When the car is traveling in the up direction, it shall stop at all floors for which car buttons or "up" hall buttons have been pressed. The car shall not stop at floors where "down" buttons have been pressed, unless the stop for that floor has been registered by a car button or unless the down call is at the highest floor for which any buttons have been pressed. Pressing the "up" button when the car is traveling in the down direction shall not intercept the travel unless the stop for that floor has been registered by a car button or unless the up call is the lowest for which any button has been pressed.
3. When the car has responded to its highest or lowest stop, and stops are registered for the opposite direction, its direction of travel shall reverse automatically and it shall then answer the calls registered for that direction. If both up and down calls are registered at an intermediate floor, only the call corresponding to the direction of car travel shall be canceled upon the stopping of the car at the landing.
4. A car that is stopping for the last hall call in the preference direction, and that hall call is for the opposite direction with no onward car calls, shall reverse preference when the selector position advances to the landing at which the car is committed to stop. A car that is stopping for the last hall call in the preference direction, and that hall call is for the same direction, shall hold its preference until the door is almost closed allowing time for a passenger to register an onward car call which shall maintain the preference. If no car call is registered

before the door is almost closed, the car shall lose its preference and shall be available to accept calls in either direction.

B. Operation: Selective Collective – ETA based. The system is optimized to get a car to the floor where a hall call has been registered, in the shortest time. The system receives input information from standard call pushbuttons located in the hall, car position and car load information from individual car loadweighers.

1. When group operation is required, the group supervisory operation shall be embedded within selected car controllers. No separate group controller shall be supplied. The microprocessor shall constantly scan the system for hall calls. When hall calls are registered, the control system shall immediately calculate the estimated time for arrival using such information as, number of floors to travel from the current position, the time it takes to travel one floor at top speed, calls assigned to a car, and car reversal time to respond to a call in the opposite direction of travel. When a car's status changes or additional hall calls are registered, the estimated time of arrival shall be recalculated and calls reassigned if necessary.
2. Traffic Pattern: The microprocessor shall provide flexibility to meet well defined patterns of traffic, including up peak, down peak, and heavy interfloor demands, and adjust for indeterminate variations in these patterns which occur in buildings.
3. Artificial Intelligence: Artificial Intelligence shall be an integral part of the group control system software. The enhanced artificial intelligence shall optimize the interfloor traffic performance. Inputs for the artificial intelligence shall include accurate passenger load from an electronic loadweigher, probable car calls generated from each hall call, type of building and observed traffic patterns.

C. Load Weighing Device: Provide a load weighing device on each car which, when the particular car is filled to an adjustable percentage of the capacity load, shall cause the car to bypass landing calls but not car calls. The passed landing calls shall remain registered for the next following car.

1. The device shall be unaffected by the action of compensating chain or rope. The device shall detect a 50-pound (23 Kg.) load change under all conditions.
2. The load sensor shall use a load cell to accurately measure the weight in the car. The information shall be transferred via a serial link to the elevator controller.

D. Anti-Nuisance Call Control: The microprocessor control system shall evaluate the number of people on the car and compare that value to the number of car calls registered. If the number of car calls exceeds the number of people by a field programmable value, the car calls shall be canceled after the first call has been answered.

E. Position Selector: The position selector shall be part of the microprocessor system. The car position in the hoistway shall be digitized through a primary position encoder. The microprocessor control system shall store the floor position and slow down points in memory.

F. Motion Control: The drive control system shall be dual-loop feedback system based primarily on car position. The velocity profile shall be calculated by the microprocessor control system producing extremely smooth and accurate stops. The velocity encoder shall permit continuous comparison of

machine speed to velocity profile and to actual car speed. This accurate position/velocity feedback shall permit a fast and accurate control of acceleration and retardation.

G. Motor Pre-Torque: Current shall be applied to the elevator drive before the brake is released and the speed pattern is dictated to eliminate roll back and sling shot effects of unbalanced loads in the car. The electronic loadweigher shall determine the load on the car determining a pre-torque reference to send to the drive.

H. Emergency Power Operation: In the event of power loss, this elevator(s) should be equipped with a battery powered automatic rescue operation device. This operation is designed to only move the car up or down to the nearest landing depending on the load in the car. It is NOT designed to lower the car to a specified landing such as Battery Lowering used for Hydraulic applications. An isolation transformer is required if the building voltage is NOT 480VAC. A single rescue unit is not capable of rescuing a group of cars --- this is a per car option. Maximum travel on rescue operation is 100 feet. Average time of operation for Rescue is 3 minutes. This feature is only available for jobs with 60HP and below. This battery automatic rescue operation is not allowed with the Green Drive.

I. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.

J. Special Operation: Not Applicable

K. Digital Services:

Cloud-based IoT Monitoring System (standard): Contractor shall provide a cloud-based IoT (internet of things) monitoring system capable of tracking door movements and timing, trips, power cycles, car calls, out-of-service events and modes. This observation will continue 24/7 and it shall be capable of providing service technicians a minimum of three recommended solutions for defined failure events and automatically dispatch service technicians in the event of failure(s) while sending notifications to end users of changes in their equipment’s state via both email and mobile device. Access to IoT and related equipment data and status will be made available in both a web portal and mobile application secured by password and username with at least two-factor authentication. Finally, this system must be self-contained and not require internet provision by others.

Along with the monitoring system, options are available.

Remote Monitoring with Application Programming Interface (API) Integration: Contractor shall provide a portal and mobile device application (app) that communicates relevant service and operational information such as elevator operational status, open service call tickets, call ticket history and performance and service history. This system shall provide a REST application programming interface (API) capable of transmitting relevant information from the cloud-based IoT monitoring system. This data includes equipment operational status, door movements, service and maintenance history, traffic statistics and failure alerts.

ADA Phone – Code Compliant Cellular Connectivity: Contractor shall provide a phone service through a self-contained cellular based VoIP system. This system shall meet code, include a backup battery capable of powering the emergency communication equipment for 4+ hours in the event of a power outage. The solution shall have remote monitoring capability to ensure continuous connectivity with a means of remote troubleshooting. Remote monitoring capability shall include, at a minimum, the ability to monitor connectivity and power supply. Remote monitoring shall be capable of providing local alerts to response personnel when on-site intervention is required.

L. Digitally Native:

The Basis of design model, EOX or equall shall haveall the components needed for digital expansion from day one. No additional technician dispatching. On-site installation or modernization is required to enable new digital services giving you confidence that your elevator will remain up-to-date for years to come.

2.09 HALL STATIONS

A. Hall Stations, General: Buttons shall illuminate to indicate call has been registered at that floor for the indicated direction.
   1. Provide one pushbutton riser with faceplates having a brushed stainless steel finish, surface-mounted in the entrance jamb.
      a. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the entrance frame at the designated level.

B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.

C. Combo Hall Lantern and Position Indicator: An electronic position indicator shall be provided and mounted for optimal viewing. As the car travels, its position in the hoistway shall be indicated by the illumination of the alphanumeric character corresponding to the landing which the elevator is stopped or passing. Hall lantern is combined in the display with the directional arrow to indicate the travel direction in the same faceplate. Faceplates shall match the hall stations.

D. Special Equipment: Not Applicable

2.10 CONTROLLER LOCATION

E. Door Jamb Mount is integrated with controller in the door jamb. Control power and cab light are provided by the elevator contractor and included with the integrated assembly. Main power disconnect is provided by the general contractor.

PART 3 EXECUTION

3.01 EXAMINATION

A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and/or control room, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

A. Install elevator systems components and coordinate installation of hoistway wall construction.
   1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
   2. Comply with the National Electrical Code for electrical work required during installation.

B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.

C. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.

D. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.

E. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.

F. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.

G. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.

H. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.

I. Lubricate operating parts of system, including ropes, as recommended by the manufacturer.

3.03 FIELD QUALITY CONTROL

A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.

B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.04 ADJUSTING

A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.05 CLEANING

A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; it shall not be cleaned with bleach-based cleansers.

B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.

1. Use environmentally preferable and low VOC emitting cleaners for each application type. Cleaners that contain solvents, pine and/or citrus oils are not permitted.

3.06 PROTECTION

A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.07 DEMONSTRATION

A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.

B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.08 ELEVATOR SCHEDULE

A. Elevator Qty. 2
   1. Elevator Model: EOX
   2. Elevator Type: Gearless Traction Machine Room-Less, Passenger
   3. Rated Capacity: 2500 lbs.
   4. Rated Speed: 150 ft./min.
   5. Operation System: EOX controller
   6. Travel: 14'-0"
   7. Landings: 2 total
   8. Openings:
      a. Front: 2
      b. Rear: 0
   9. Clear Car Inside: 6'-9" wide x 4'-3 1/2" deep
   10. Inside clear height: 7'-4" standard
   11. Door clear height: 7'-0" standard
   12. Hoistway Entrance Size: 3'-6" wide x 7'-0" high
   13. Door Type: One-speed | LH Side opening
   14. Power Characteristics: volts, 3 Phase, 60 Hz.
      a. Note: Isolation Transformer required for jobs with less than 460vac as well as 575vac, 3 Phase building power.
   15. Seismic Requirements: Yes.
   16. Hoistway Dimensions: 8'-6" wide x 5'-9" deep
      a. Note: Hoistway dimensions listed above are for Non-Seismic areas only. If you have chosen the option for seismic requirements, please consult your provider Elevator Sales Representative for the proper hoistway dimensions.
   17. Pit Depth: 4'-0"
   18. Button & Fixture Style: EOX, or approved equal Signal Fixtures
   19. Special Operations: None
   20. Digital Services:
   21. Remote Monitoring with Application Programming Interface (API) Integration
   22. ADA Phone - Code Compliant Cellular Connectivity
   23. Digitally Native

3.09 SPECIAL CONDITIONS (Note: Add Special Conditions as Needed)

END OF SECTION

SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Silicone sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.

C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

D. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Description: Manufactured, Dura-coated or Duco-coated or galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20 psig minimum.
3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
4. Pressure Plates: Carbon steel or Stainless steel.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633 or Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

B. Plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.6 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.

B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at

pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Use silicone sealant to seal around the outside of stack-sleeve fittings.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- or smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Use grout or silicone sealant, to seal the space around outside of sleeve-seal fittings.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping NPS 6 or Smaller: Cast-iron pipe sleeves or Steel pipe sleeves or Sleeve-seal fittings.

2. Exterior Concrete Walls below Grade:

a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system or Steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system or Steel pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping NPS 6 or smaller: Cast-iron pipe sleeves with sleeve-seal system or Steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6: Steel pipe sleeves or PVC pipe sleeves or Stack-sleeve fittings or Sleeve-seal fittings or Molded-PE or -PP sleeves or Molded-PVC sleeves.

b. Piping NPS 6 and Larger: Steel pipe sleeves or PVC pipe sleeves or Stack-sleeve fittings.

5. Interior Partitions:

   a. Piping Smaller Than NPS 6: Steel pipe sleeves or PVC pipe sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION 210517

SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel or brass with polished, chrome-plated finish and spring-clip fasteners.

E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.

2.3 FLOOR PLATES

A. Split Floor Plates: Steel with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge or split-plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge or split-plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
h. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
i. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated or rough-brass finish.
j. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge or split-plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor plate.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 210518

SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE SUPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Fastener systems.
5. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 210516 "Expansion Fittings and Loops for Fire-Suppression Piping" for pipe guides and anchors.
3. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment", “Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for vibration isolation devices and seismic restraints.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for fire-suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to [ASCE/SEI 7]

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

C. NFPA Compliance: Comply with NFPA 13

D. UL Compliance: Comply with UL 203.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.

3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel, stainless steel .

B. Copper Pipe and Tube Hangers:

1. Description: Copper-coated-steel, factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel, stainless steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel channel with inturned lips.
4. Channel Width: Selected for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: No coating, Plain, Pregalvanized G90 (Z275), Electroplated zinc, Hot-dip galvanized, Gold (yellow zinc dichromate) galvanized.
8. Paint Coating: Green epoxy, acrylic, or urethane.
9. Combination Coating: As per manufacturer standard.

B. Non-MFMA Manufacturer Metal Framing Systems:
1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel channel with inturned lips.
4. Channel Width: Select for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: No coating, Plain, Pregalvanized G90 (Z275), Hot-dip galvanized.
8. Paint Coating: Green epoxy, acrylic, or urethane.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM-approved threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. chanical-Expansion Anchors: NFPA-approved, UL-listed, or FM-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
2. Indoor Applications: Zinc-coated or Stainless steel.
3. Outdoor Applications: Stainless steel.

2.6 EQUIPMENT SUPPORTS

A. Description: NFPA-approved, UL-listed, or FM-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

2.7 MATERIALS

A. Aluminum: ASTM B 221 (ASTM B 221M).

B. Carbon Steel: ASTM A 1011/A 1011M.

C. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A 240/A 240M.

E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal strut systems.

D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Install in accordance with approvals and listings.
2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Install in accordance with approvals and listings.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2 : 12 inches long and 0.048 inch thick.
   b. NPS 4 : 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6 : 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in 09 spec series "Exterior Painting.", "Interior Painting." and "High-Performance Coatings."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

E. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

F. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Comply with NFPA requirements.

I. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. C-Clamps (MSS Type 23): For structural shapes.
3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

J. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

K. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 210529

SECTION 210548 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Resilient pipe guides.
   2. Elastomeric hangers.
   3. Restraint channel bracings.
   4. Seismic-restraint accessories.
   5. Mechanical anchor bolts.
   6. Adhesive anchor bolts.

B. Related Requirements:

   1. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.
   2. Section 230548 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES, OSHPD, an agency acceptable to authorities having jurisdiction.
b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
4. Seismic-Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, OSHPD an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval tests or calculations.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for fire-suppression piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: As mentioned in the A and G series dwgs.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: As mentioned in the A and G series dwgs.

    a. Component Importance Factor: 1.0, 1.5.
    b. Component Response Modification Factor: 1.5, 2.5, 3.5, 5.0.
    c. Component Amplification Factor: 1.0, 2.5.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second).
4. Design Spectral Response Acceleration at 1.0-Second Period.
5. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES, OSHPD, an agency acceptable to authorities having jurisdiction.

    a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

2.2 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post-and-sleeve arrangement separated by a minimum 1/2-inch thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.3 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.4 SNUBBERS

A. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch thick resilient cushion.

2.5 RESTRAINT CHANNEL BRACINGS

A. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.6 SEISMIC-RESTRAINT ACCESSORIES

A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections, Reinforcing steel angle clamped to hanger rod.

B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings.

C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.7 MECHANICAL ANCHOR BOLTS

A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.8 ADHESIVE ANCHOR BOLTS

A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES, OSHPD an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Spec section 03 "Cast-in-Place Concrete." and "Miscellaneous Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in Section 077200 "Roof Accessories" for installation of equipment supports and roof penetrations.

D. Equipment Restraints:

1. Install seismic snubbers on fire-suppression equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by [an evaluation service member of ICC-ES, OSHPD an agency acceptable to authorities having jurisdiction that provides required submittals for component.

E. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

F. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES, OSHPD, an agency acceptable to authorities having jurisdiction] that provides required submittals for component.

G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

J. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 211200 "Fire-Suppression Standpipes," Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.

3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

END OF SECTION 210548

SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

D. Valve Schedules: Valve numbering scheme.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032 inch or stainless steel, 0.025 inch or aluminum, 0.032 inch or anodized aluminum, 0.032 inch thick, with predrilled holes for attachment hardware.
2. Letter Color: Red or White.
3. Background Color: Red or White. Shall be contrasting with letter color.

4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch or 1/8 inch thick, with predrilled holes for attachment hardware.
2. Letter Color: Red or White.
3. Background Color: Red or White. Shall be contrasting with letter color.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch or 1/8 inch thick, with predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

Retain this article if labeling devices identify some or all piping. Identification of piping by color-coded painting is covered in "Pipe Label Installation" Article.

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover or cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.

Retain second option in "Lettering Size" Subparagraph below if visibility due to distance from piping is an issue.

2. Lettering Size: Size letters according to ASME A13.1 for piping or at least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

D. Pipe-Label Colors:

Colors listed in "Background Color" and "Letter Color" subparagraphs below are from ASME A13.1. Note also that all colors listed in ASME A13.1 that are preceded by the word "Safety" are required to comply with ANSI Z535.1.

1. Background Color: Safety Red.
2. Letter Color: White.

2.4 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032 inch or stainless steel, 0.025 inch or aluminum, 0.032 inch or anodized aluminum, 0.032 inch thick, with predrilled holes for attachment hardware.
2. Fasteners: Brass wire-link or chain beaded chain or S-hook.
3. Valve-Tag Color: Safety Red.
4. Letter Color: White.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Description: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum or approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire or Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

Designer to verify against project specifications for which painting spec is used. Edit accordingly.

A. Piping: Painting of piping is specified in Section 09 series "Interior Painting." and "High-Performance Coatings."

B. Stenciled Pipe-Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors and similar access points that permit a view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 15 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes including pipes where flow is allowed in both directions.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:

a. Fire-Suppression Standpipe: 1-1/2 inches or 2 inches, round or square.
b. Wet-Pipe Sprinkler System: 1-1/2 inches or 2 inches, round or square.
c. Dry-Pipe Sprinkler System: 1-1/2 inches or 2 inches, round or square.

3.6 HYDRAULIC DESIGN INFORMATION SIGN

A. Install a permanently marked weatherproof metal or rigid plastic sign secured with corrosion-resistant wire, chain, or other approved means at the system riser that includes the following information:
   1. Location of the design area or areas.
   2. Discharge densities over the design area or areas.
   3. Required flow and residual pressure demand at the base of the riser.
   4. Occupancy classification or commodity classification and maximum permitted storage height and configuration.
   5. Hose stream allowance included in addition to the sprinkler demand.
   6. The name of the installing contractor.

3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 210553

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Specialty valves.
3. Valves.
4. Sprinklers.
5. Alarm devices.
6. Pressure gages.
7. Backflow preventers.
8. Fire department connections.

B. Related Requirements:
1. Section 210517 “Sleeves and Sleeve Seals for Fire-Suppression Piping”
2. Section 210518 “Escutcheons for Fire-Suppression Piping”
3. Section 210553 “Identification for Fire-Suppression Piping and Equipment”

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings and hydraulic calculations:

1. Include plans, elevations, sections, and attachment details and hydraulic calculations in accordance with NFPA 13 “Plans and Calculations” Chapter. Hydraulic nodes shall be visibly shown on the drawings.

2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer or NICET III or IV technician responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. All Plumbing Piping.
2. All HVAC piping.
3. All other trades piping and equipment.
4. Items penetrating finished ceiling include the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Fire alarm devices.
d. Security/communications devices.

B. Qualification Data:
1. Qualified Installer
2. Professional engineer or NICET III or IV technician responsible for the preparation of shop drawings, hydraulic calculations, and product data submittal package.

C. Design Data:

1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.

D. Welding certificates.

E. Field Test Reports:

1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
2. Fire-hydrant flow test report.

F. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench.. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project. The stock of spare sprinklers shall include all types and ratings installed and shall be as follows:
   a. Protected facilities having under 300 sprinklers – no fewer than six sprinklers.
   b. Protected facilities having 300 to 1000 sprinklers – no fewer than 12 sprinklers.
   c. Protected facilities having over 1000 sprinklers – no fewer than 24 sprinklers.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test not less than one year old from the date of shop drawing submittal.

   a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified NICET III or IV technician or professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

C. All fire protection materials and equipment shall be UL listed and/or FM approved. Valve components (including valve trim, internal parts, gaskets, etc.) and other components as permitted by NFPA 13 shall not be required to be individually listed.

D. Piping materials shall bear label, stamps, or other markings of specified testing agency.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves and piping according to the following:
1. Ensure that valves and piping are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves according to the following:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather, humidity, temperature, dust, dirt, and water damage. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

D. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

E. Protect flanges, fittings, and specialties from moisture and dirt.

F. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Engage a qualified professional engineer or NICET III or IV technician, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.

1. Refer to fire protection drawings for fire-hydrant flow test records.

2. Sprinkler system design shall be approved by authorities having jurisdiction.

a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
b. Sprinkler Occupancy Hazard Classifications:

1) Light Hazard Occupancy: Offices, lobbies, conference rooms, classrooms, restrooms, sleeping rooms, and similar spaces.
2) Ordinary Hazard Group 1 Occupancy: Electrical, telecom, mechanical, parking garage, general storage rooms, kitchens, laundry rooms, and similar spaces.

3. Minimum Density for Automatic-Sprinkler Piping Design:
a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
4. Hose stream requirement:
a. Light Hazard Occupancy: 100 gpm.
Ordinary Hazard Occupancy: 250 gpm.
5. Maximum Protection Area per Sprinkler: According to UL listing and below.
a. Light Hazard Occupancy: 225 sq. ft..
b. Ordinary Hazard Group 1 and 2 Occupancy: 130 sq. ft..

6. The design area is permitted to be reduced for use of quick-response sprinklers in accordance with NFPA 13.

2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 2.5 and larger.

C. Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

D. Galvanized- and Uncoated-Steel Couplings: ASTM A 865/A 865M, threaded.

E. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

F. Malleable- or Ductile-Iron Unions: UL 860.

G. Cast-Iron Flanges: ASME 16.1, Class 125.

H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or EPDM rubber gasket.

a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.

2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.

I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

J. Grooved-Joint, Steel-Pipe Appurtenances:
1. Pressure Rating: 175-psig minimum.
2. Galvanized, Painted, Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 BACKFLOW PREVENTERS

A. Double-Check, Detector-Assembly Backflow Preventers:
   1. Standards: ASSE 1048 and UL's "Fire Protection Equipment Directory" listing or FM Global's "Approval Guide."
   2. Operation: Continuous-pressure applications.
   3. Pressure Loss: per manufacturer's pressure loss graph.
   4. Size: As per design drawings.
   5. Body Material: Cast iron with interior lining complying with AWWC C550 or that is FDA approved or steel with interior lining complying with AWWA C550 or that is FDA approved or stainless steel.
   6. End connections: Flanged.
   7. Configuration: Horizontal
   8. Accessories:
      a. Valves: UL 262 and FM Global's "Approval Guide" listing; OS&Y gate type with flanged ends on inlet and outlet.
      b. Bypass: with displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

B. Backflow Preventer Test Kits:
   1. Description: Factory calibrated, with gages, fittings, hoses,, and carrying case with test-procedure instructions.

2.4 VALVES

A. Two-piece ball valves with indicators
   1. Standard: UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
   2. Pressure Rating: 175 psig minimum.
   3. Body Design: Two piece.
   4. Body Material: Forged brass or bronze.
   5. Port Size: Full or standard.
   6. Seats: PTFE.
   7. Stem: Bronze or stainless steel.
   8. Ball: Chrome-plated brass.
   9. Actuator: Worm gear or traveling nut.
   10. End Connections: Threaded ends.

B. Globe valves
   1. Pressure Rating: 175 psig minimum.
   2. Body Material: Bronze with integral seat and screw-in bonnet.
   3. Stem: Bronze.
   4. Disc Holder and Nut: Bronze.
   5. Disc Seat: Nitrile.
   6. Packing: Asbestos free.
   7. Handwheel: Malleable iron, bronze, or aluminum.
   8. End Connections: Threaded ends.

C. Butterfly valves with indicators
   1. Standard: UL 1091 and FM Global standard for indicating valves, Class Number 1112.
   2. Pressure Rating: 175 psig minimum.
   3. Body Material: Bronze for NPS 1 through 2-1/2. Cast or ductile iron for NPS 2-1/2 and larger.
   4. Seat Material: EPDM.
   5. Stem Material: Bronze for NPS 1 through 2-1/2. Stainless steel for NPS 2-1/2 and larger.
   6. Disc: Bronze for NPS 1 through 2-1/2. Ductile iron for NPS 2-1/2 and larger.
   7. Actuator: Worm gear or traveling nut.
   8. Supervisory Switch: Internal or external.
   9. Body Design: Threaded ends for NPS 1 through NPS 2. Grooved ends for NPS 2-1/2 and larger.

D. Check valves
   1. Standard: UL 262 and FM Global standard for swing check valves, Class Number 1210.
   2. Pressure Rating: 175 psig minimum.
   3. Type: Single swing check.
   4. Body Material: Cast iron, ductile iron, or bronze.
   5. Clapper: Bronze, ductile iron, or stainless steel.
   6. Hinge Shaft: Bronze or stainless steel.
   7. Hinge Spring: Stainless steel.
   8. End Connections: Flanged, grooved, or threaded.

E. OS&Y Gate Valves
   1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y gate valves).
   2. Pressure Rating: 175 psig minimum.
   3. Body and Bonnet Material: Cast or ductile iron.
   4. Wedge: Cast or ductile iron.
   5. Wedge Seat: Cast or ductile iron.
   6. Stem: Brass or bronze.
   7. Packing: Non-asbestos PTFE.
   8. Supervisory Switch: External.
   9. End connections: Flanged or grooved.

2.5 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:

   1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Riser Check Valve Assembly:
1. Standard: UL listed HMER
2. Design: For horizontal or vertical installation.
3. Include trim sets for drain and pressure gages.

G. Automatic (Ball Drip) Drain Valves:
1. Standard: UL 1726.
2. Pressure Rating: 175-psig minimum.
3. Type: Automatic draining, ball check.
4. Size: NPS 3/4.
5. End Connections: Threaded.

H. Pressure Relief Valve:
1. Standard: UL listed or FM approved for use in fire protection systems.
2. Pressure Rating: 175-psig minimum.
3. Size: NPS 1/2 minimum.

I. Automatic air venting valve:
1. Standard: UL 2573
2. Pressure rating: 175-psig minimum.
3. Body Material: Brass construction
4. Size: NPS 1/2 minimum.
5. End Connections: Threaded.

2.6 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:
1. Standard: UL 213.
2. Pressure Rating: 175-psig minimum.
3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
4. Type: Mechanical-tee and -cross fittings.
5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Sprinkler Inspector's Test Fittings:
1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
2. Pressure Rating: 175-psig minimum.
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

C. Adjustable Drop Nipples:
1. Standard: UL 1474.
2. Pressure Rating: 250-psig minimum.
3. Body Material: Steel pipe with EPDM-rubber O-ring seals.
4. Size: Same as connected piping.

5. Length: Adjustable.
6. Inlet and Outlet: Threaded.

D. Flexible Sprinkler Hose Fittings:
1. Standard: UL 1474.
2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
3. Pressure Rating: 175-psig minimum.
4. Size: Same as connected piping, for sprinkler.

2.7 SPRINKLERS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating for Residential Sprinklers: 175-psig maximum.

C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

D. Automatic Sprinklers with Heat-Responsive Element:
1. Nonresidential Applications: UL 199.
2. Residential Applications: UL 1626.
3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

4. Nominal Orifice: 1/2 inch, with discharge coefficient K up to 5.8.
5. Nominal Orifice: 1/2 inch or 3/4 inch with discharge coefficient K between 7.4 and 11.2.

E. Sprinkler Finishes: Chrome plated, bronze, and painted. Refer to sprinkler schedule.

F. Special Coatings: corrosion-resistant paint. Refer to sprinkler schedule.

G. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat or Plastic, white finish, one piece, flat.
2. Sidewall Mounting: Chrome-plated steel or Plastic, white finish, one piece, flat.

H. Sprinkler Guards:
1. Standard: UL 199.
2. Type: Wire cage with fastening device for attaching to sprinkler.

2.8 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:
   1. Standard: UL 464.
   2. Type: Vibrating, metal alarm bell.
   3. Size: 6-inch minimum- diameter.
   4. Finish: Red-enamel factory finish, suitable for outdoor use.
   5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Water-Flow Indicators:
   1. Standard: UL 346.
   2. Water-Flow Detector: Electrically supervised.
   3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
   4. Type: Paddle operated.
   5. Pressure Rating: 250 psig.
   6. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:
   1. Standard: UL 346.
   2. Type: Electrically supervised.
   3. Components: Single-pole, double-throw switch with normally closed contacts.
   4. Design: Signals that controlled valve is in other than fully open position.
   5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.9 PRESSURE GAGES

A. Standard: UL 393.

B. Dial Size: 3-1/2- to 4-1/2-inch diameter.

C. Pressure Gage Range: 0- to 250-psig minimum.

D. Label: Include "WATER" label on dial face.

2.10 FIRE DEPARTMENT CONNECTIONS

A. Freestanding fire department connection
   1. Standard: UL 405.
   2. Type: Exposed, freestanding.
   3. Pressure Rating: 175 psig minimum.
   4. Body Material: Corrosion-resistant metal.

5. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
6. Caps: Brass, lugged type, with gasket and chain.
7. Escutcheon Plate: Rectangular, brass, wall type.
8. Outlet: Bottom with pipe threads.
9. Number of Inlets: Two.
10. Sleeve: Brass.
11. Sleeve Height: 18 inches.
12. Escutcheon Plate Marking: Similar to "AUTO SPKR"
13. Finish: Polished chrome plated
14. Outlet Size: NPS 4

2.11 AIR VENT FOR WET AND DRY SPRINKLERS

PIPE AND FITTINGS. Pipe and fittings for connection of air vent device to sprinkler piping.

A. Pipe - Schedule 40 Steel, per ASTM A53 / A53M - Specification for Pipe, Steel, Black, Welded and Seamless.

B. Nipples - Steel Pipe Nipples, Threaded End, per ASTM A733 - Specification for Welded and Seamless Carbon Steel Pipe Nipples.

C. Fittings - All fittings shall be black. Galvanized fittings shall not be used. Fittings per ANSI B16.3 - Malleable Iron Threaded Fittings, or ANSI B16.4 - Cast Iron Threaded Fittings.

D. Couplings - Per ASTM A865 - Specification for Threaded Couplings, Steel, Black, Welded or Seamless, for Use in Steel Pipe Joints.

E. Unions. Use unions only as necessary where joining pipe is impossible or impractical without them. Unions per ANSI B16.39 - Malleable Iron Threaded Pipe Unions.

F. Threads - Threaded ends per ANSI B2.1 - Basic Standards for Steel Pipe Threads, and ANSI B1.20.1 - Pipe Threads, General Purpose (Inch). All threads shall be NPT.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results provided on fire protection design drawings. Contractor shall conduct a new flow test if the date of the flow test provided on fire protection design drawings exceed 12 months from the date of working plan submittal.

B. Report test results promptly and in writing.

3.2 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated on the drawings. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support NPS 2-1/2 and larger backflow preventers and piping on concrete piers. Comply with requirements for concrete piers in Section 033000 “Cast-in-Place Concrete.”

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage. Where low points cannot be avoided, auxiliary drains shall be provided in accordance with NFPA 13.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valve at low point in the fire-department connection piping system, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

L. Install pressure gages on riser or feed main and at each sprinkler test connection. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

M. Fill sprinkler system piping with water.

N. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."

O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventer of type, size and capacity indicated on the drawings. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support NPS 2-1/2 and larger backflow preventers and piping on concrete piers. Comply with requirements for concrete piers in Section 033000 “Cast-in-Place Concrete.”

3.6 VALVE AND SPECIALTIES INSTALLATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

F. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

G. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

H. Install backflow preventers instead of check valves in potable-water-supply sources.

I. Specialty Valves:

1. Install valves in vertical position for proper direction of flow, in main supply to system.
2. Install riser check valves with drain outlet and pressure gage trim assembly.
3. Install NPS 1/2 minimum pressure relief valve at the riser or at floor control valve assemblies downstream of check valves.
4. Install automatic NPS 1/2 minimum automatic air vent valve at a high point in the sprinkler system to allow air to be removed from that portion of the system.

3.7 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.8 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Hydrostatic test: After installation, all piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at 200 psi and shall maintain that pressure without loss for 2 hours. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Main drain valve test shall be performed, and the resulting static and residual pressure recorded in accordance with NFPA 13.
5. All control valves shall be fully closed and opened under system working pressure to ensure proper operation.
6. Energize circuits to electrical equipment and devices.
7. Coordinate with fire-alarm tests. Operate as required.

8. Coordinate with fire-pump tests. Operate as required.
9. Verify that equipment hose threads are same as local fire department equipment.
10. Backflow prevention assembly shall be forward flow tested at sprinkler system demand including hose stream allowance where applicable to ensure proper operation.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.11 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain installed sprinkler system.

3.12 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Schedule-40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule-40, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Schedule-40, black-steel pipe with plain ends; steel welding fittings; and welded joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 and larger, shall be one of the following:

1. Standard-weight, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
3. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. Schedule 10 black-steel pipe with plain ends; welding fittings; and welded joints.

3.13 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Recessed sprinklers, Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Pendent, dry sprinklers, Sidewall, dry sprinklers.
5. Special Applications: Extended-coverage where indicated, Attic sprinklers, Combustible concealed space sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
3. Residential Sprinklers: Dull chrome.
4. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.
5. Sprinklers in areas subject to moisture/condensation shall be provided with corrosion resistant finish. This includes, but is not limited to, shower rooms, dishwashing areas, and similar spaces.

END OF SECTION 211313

SECTION 211319 - Pre-Action Sprinkler system with Nitrogen system

PART 1 - GENERAL

1.1 SUMMARY

A. This section outlines the requirements for the nitrogen-generating sprinkler corrosion inhibiting system. The work described in this section includes all engineering, labor, materials, equipment, and service required to design, supply, install, test, and commission the system.

B. Section includes:

1. Nitrogen-generating sprinkler corrosion inhibiting system.

2. Pipe, fittings, and specialties.

3. Preaction system assembly in enclosure.

4. Fire detectors.

5. Alarm notification devices.

1.2 RELATED SECTIONS:

A. 01 43 00 Quality Control.

B. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections.

1.3 REFERENCES

A. ASTM International (ASTM):

1. A53 / A53M – Standard Specification for Pipe, Steel, Black, Welded and Seamless.

2. A135 / A135M – Standard Specification for Electric-Resistance-Welded Steel Pipe.

3. A234 / A234M – Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

4. A733 – Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.

5. A865 – Standard Specification for Threaded Couplings, Steel, Black, Welded or Seamless, for Use in Steel Pipe Joints.

B. American National Standards Institute (ANSI):

1. B2.1 – Basic Standards for Steel Pipe Threads.
2. B16.3 – Malleable Iron Threaded Fittings.
3. B16.39 – Malleable Iron Threaded Pipe Unions.
4. B1.20.1 – Pipe Threads, General Purpose (Inch).

C. American Water Works Association (AWWA): C606 – Grooved and Shouldered Joints.

D. FM Approvals Class Number 1035 – Approval Standard for Nitrogen Generators.

E. All applicable State Building Codes.

F. All applicable State Fire Codes.

G. All requirements of local fire department

H. Underwriters Laboratories (UL):

- UL 260 – Dry Pipe and Deluge Valves for Fire Protection Service.
- UL 268 – Smoke Detectors for Fire Alarm Systems.
- UL 864, 9th Edition – Control Units and Accessories for Fire Alarm Systems.

Factory Mutual (FM):

- Class Numbers 1011 / 1012 / 1013 – Deluge and Preaction Systems.
- Class Number 1020 – Automatic Water Control Valves.
- Class Number 3010 – Fire Alarm Signaling Systems.
- Class Number 3230 – Smoke Actuated Detectors for Automatic Fire Alarm Signaling.
- Property Loss Prevention Data Sheet 2-0 – Automatic Sprinkler Systems.
- Property Loss Prevention Data Sheet 5-40 – Fire Alarm Systems.

National Fire Protection Association (NFPA):

- NFPA 13 – Installation of Sprinkler Systems.
- NFPA 70 – National Electrical Code.
- NFPA 72 – National Fire Alarm and Signaling Code.

ASTM International (ASTM):

- A53 / A53M – Standard Specification for Pipe, Steel, Black, Welded and Seamless.
- A135 / A135M – Standard Specification for Electric-Resistance-Welded Steel Pipe.
- A234 / A234M – Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- A733 – Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.
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- B16.3 – Malleable Iron Threaded Fittings.
- B16.39 – Malleable Iron Threaded Pipe Unions.
- B1.20.1 – Pipe Threads, General Purpose (Inch).

1.4 SYSTEM DESCRIPTION

A. Provide all required engineering, equipment, materials, labor, and services necessary for a complete FM Approved sprinkler corrosion inhibiting system that fills the preaction sprinkler piping with 98% nitrogen at required supervisory pressure. The system shall consist of below or packaged in a single cabinet per mentioned in the design drawings:

1. An FM Approved, self-contained, factory-assembled nitrogen generator unit with:

    a. Oilless twin-head rocking-piston compressor.

    b. Intercooler, water separator, and fan with air filter to produce dry air.

    c. Particle and coalescing filters.

    d. Nitrogen membrane separator.

    e. Manual bypass valve.

f. Terminal strip for field attachment of 120 VAC 60 Hz single-phase power.

g. On / off selector switch.

h. Outlet shutoff valve.

i. Digital compressor runtime monitor.

j. Two (2) pressure gauges to monitor gas pressure up stream and downstream of separator membrane.

k. Visual indicators for normal and bypass modes.

l. Single drain connection point for all required drains.

2. Nitrogen receiver for receiving and storing nitrogen.

3. Device(s) for automatic regulation of nitrogen and air pressure to the preaction sprinkler valve. .

4. Purge vent assembly(ies) with attachment point for field attachment of plenum-rated sampling tubing or included in the packaged cabinet per mentioned in the design drawings.

5. Device(s) for automatic control of purging and permanently installed and connected nitrogen concentration display and shall consist of below or the package one included in the cabinet per mentioned in the design drawings:

a. Zirconium dioxide-based gas sensor.

b. Active drift control (ADC™); automatic analysis of gas sensor drift and application of correlation and gain offsets.

c. Steel enclosure.

d. Attachment point for field attachment of plenum-rated sampling tubing from purge vent assembly.

e. Programmable logic controller with display.

f. Five (5) programmable control buttons.

g. Automatic gas sampling and permanent display of nitrogen concentration on PLC display.

h. Automatic purge mode.

i. Display of purge status, time, and date.

j. Terminal strip for field attachment of 120 VAC 60 Hz single-phase power.

k. Normally-open volt-free contacts to annunciate unit fault conditions.

6. Corrosion monitor assembly(ies) that will provide a volt-free contact which closes upon corrosion perforation of a specifically-designed probe.

7. A hand-held nitrogen analyser for use with the sampling outlet within the nitrogen generator assembly.

8. Steel pipe or approved tubing to connect the self-contained unit to the preaction sprinkler system.

1.5 PERFORMANCE REQUIREMENTS

A. General.

1. Design and performance of systems, components, and methods specified herein shall comply with all applicable referenced codes and standards.

2. Contract drawings indicate the general arrangement of the system and are a guide for intent only. Contractor is responsible for providing and installing all equipment necessary to complete the installation in compliance with all applicable requirements.

3. Contractor shall design, furnish, and install the nitrogen corrosion inhibiting system per this specification, and shall provide Professional Engineering services needed to assume Engineering responsibility.

4. All equipment and materials shall be new and unused.

B. Nitrogen System Design.

1. The system shall be sized and configured so that the NFPA 13 – 2016 section 7.2.6.3.2 requirement for maximum 30 minute initial fill with and subsequent restoration of air pressure is capable of being accomplished by the air compressor unit. If there are multiple preaction sprinkler systems connected to the unit, it is acceptable for the system to be sized for the largest volume preaction sprinkler system.

2. The system shall be sized and configured to supply sufficient nitrogen to achieve 98% minimum nitrogen concentration in the largest volume preaction sprinkler system in 2 weeks or less, and to supply sufficient nitrogen to keep the nitrogen concentration at or above 98% in the presence of the maximum permissible leakage per NFPA 13 – 2016 section 25.2.2.1.

C. PREACTION SPRINKLER SYSTEM

General.

- Design and performance of systems, components, and methods specified herein shall comply with all applicable referenced codes and standards.

- Contract drawings indicate the general arrangement of the system and are a guide for intent only. Contractor is responsible for providing and installing all equipment necessary to complete the installation in compliance with all applicable requirements.

- Contractor shall design, furnish, and install the preaction sprinkler system(s) per this specification, and shall provide Professional Engineering services needed to assume Engineering responsibility.

- Contractor is responsible for system layout in the fire zones indicated as "Pre-Action" on the contract drawings, including spacing and location of sprinkler heads, pipe size and pipe routing, location and number of preaction enclosures, and all other details required by applicable standards.

- All equipment and materials shall be new and unused.

D. Fire Detection Design.

Standards.

- FM Property Loss Prevention Sheet 5-40 – Fire Alarm Systems.

- FM Number 3010 – Fire Alarm Signaling Systems.

- NFPA 70 – National Electrical Code.

- NFPA 72 – National Fire Alarm Code.

Requirements.

Power.

Primary. Primary power shall be from a 120 VAC 60 Hz single-phase dedicated branch circuit. A primary power calculation that details the power requirements for the Kidde Aries-SLX control panel and all field devices such as smoke detectors, notification appliances and releasing solenoids shall be performed.

Standby. Standby power shall be provided by rechargeable gel-cell batteries installed in the PREACTION-PAC™ electrical enclosure. A secondary power calculation that shows the quiescent and alarm power requirements for the Kidde Aries-SLX control panel and all field devices shall be performed.

Quiescent power requirement = 24 hours.

Alarm power requirement = 5 minutes.

Wire Sizes. Voltage drop calculations shall be performed justifying the wire sizes of all 24 VDC circuits.

E. System Operation - Double Interlock
   1. Both an alarm signal from the separate fire detection control panel AND the activation by heat of an automatic sprinkler head are necessary to cause water to discharge.
   2. An alarm signal from the separate fire detection control panel BEFORE activation by heat of an automatic sprinkler head shall NOT allow water to enter the sprinkler piping.
   3. The activation by heat of an automatic sprinkler head AFTER an alarm signal from the separate fire detection control panel shall:
   4. Sense the pressure loss in the system piping through the actuation of a pneumatic actuator (known as "pneumatic –electric release"). Systems which sense system piping pressure loss through actuation of an electric low pressure switch (known as "electric-electric release') are NOT acceptable and will not be considered equal.
   5. Allow water to enter the sprinkler piping.
   6. Discharge water from activated sprinkler heads.
   7. The activation by heat of an automatic sprinkler head OR a break or air leak in the sprinkler piping BEFORE an alarm signal from the separate fire detection control panel shall NOT allow water to enter the sprinkler piping.
   8. Operation of the emergency manual release valve integral with the PREACTION-PAC™ shall open the preaction valve and allow water to enter the sprinkler piping.

1.7 QUALITY ASSURANCE

A. Perform a level of Quality Control in accordance with Section 01 43 00.

B. Furnish a Quality Work Plan per Section 01 43 00 for this work.

C. Shop drawings and design calculations shall include a seal and signature by a qualified Licensed Professional Engineer, registered in the State where jobsite is located.

1.8 SUBMITTALS

A. General Requirements. The Engineer shall review all submittals for conformance to the contract drawings and specifications. The contractor shall be required to resubmit any materials, with appropriate modifications, that are found to be in non-conformance with the requirements of the contract drawings and these specifications after review by the Engineer. Approval of the submittals by the Engineer shall not relieve the Contractor of their responsibility to meet the requirements of the drawings and specifications.

B. Product Data. For each type of product indicated in 1.4, include, as applicable, dimensions, mounting details, weight, product rated capacities, operational characteristics, electrical characteristics, materials of construction, standards of construction, approvals, and manufacturer part number.

C. Shop Drawings. Include all pertinent information such as structural members, ceiling construction, partitions, lighting fixtures, air diffusers and registers, speakers, and piping runs.

   1. Plan views of all rooms showing where all nitrogen generating equipment is located, including mechanical and electrical connections.

2. Plan views of all areas where intermediate pipe runs are located.

3. All details necessary for proper evaluation and installation of design, including:

   a. Normal pressure values (in PSIG) to be expected on all pressure gauges.

   b. System normal adjustment values.

   c. Provisions for testing and commissioning.

D. Calculations. System sizing calculation, including the preaction sprinkler system size(s) (in gallons), and a calculation to substantiate nitrogen generator system size selection. The system sizing calculation shall take into account the volume of all piping networks, the largest single piping network, the system piping allowable leakage rate permitted by NFPA 13, and the purging sequence that establishes 98% nitrogen throughout the piping network. The system assembly shall be sized to have sufficient capacity (in SCFM) to provide sufficient nitrogen generation rate to maintain minimum 98% nitrogen concentration throughout the preaction sprinkler piping network. In addition, the device shall be sized to comply with the maximum 30 minute initial-fill with air requirement (from NFPA 13) into the largest preaction sprinkler riser connected to the system.

E. Delegated-Design Submittals. Include performance requirements and design criteria analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Information Submittals.

1. Qualification data for installing contractor.

2. Qualification data for professional engineer.

G. Commissioning Submittal: Field Test Plan.

H. Closeout Submittals. Provide six (6) sets of:

1. As-built drawings.

2. Commissioning checklist(s) from nitrogen system manufacturer, properly filled in at the time of commissioning, including written verification of minimum 98% nitrogen purity at each purge vent assembly.

3. Operation and maintenance instructions, including:

   a. Checklist for monthly inspection.

   b. Checklist for annual maintenance.

   c. Instruction manual for nitrogen generation system.

d. Instruction manual for Model TAP-G3 (TRUE ADVANCED PURGE™ with ADC™) assembly.

e. List of recommended maintenance parts.

4. Copy of warranty. All equipment and installation shall be warranted against defects for a minimum of 24 months starting on the date of system acceptance by all parties.

PART 2 - PRODUCTS

2.1 SPRINKLER CORROSION INHIBITING SYSTEM. Furnish and install an FM Approved nitrogen generating preaction sprinkler corrosion inhibiting system. This system shall provide nitrogen for supervisory pressure of the preaction sprinkler system pipe(s) instead of air.

A. General Requirements.

1. The nitrogen generating system shall provide a minimum of 98% purity nitrogen within the preaction sprinkler pipe after a reasonable time allowed for purging.

2. AC circuits, of the proper phase, current, and voltage rating, shall be provided and installed by the Electrical Contractor.

B. Specific Product Requirements.

1. Self-Contained System Assembly. A self-contained, factory-assembled, FM Approved system assembly for delivering 98% dry nitrogen shall be provided. All parts of the self-contained system assembly shall work together as a system. The assembly shall be properly sized to deliver the proper volume of initial-fill air and 98% nitrogen to the preaction sprinkler system(s) to be protected. The self-contained system shall consist of the following parts:

a. Compressor. The compressor shall be a single unit equipped with an oilless twin-head rocking-piston air pump, electric motor, and start capacitor. The compressor shall be factory-assembled to the self-contained system assembly. The compressor shall use 120 VAC 60 Hz single-phase power or per mentioned in the design drawings.

b. Intercooler, Water Separator, and Fan. An intercooler, water separator, and fan shall be supplied to remove condensation moisture from the air supplied by the compressor. These devices shall be factory-assembled inside the to the self-contained system assembly cabinet.

c. Two-Stage Filtration. Factory-assembled particulate and coalescing filters shall separate pariculates and oil from the dried compressed air entering the nitrogen separator membrane, to facilitate long membrane service life.

d. Nitrogen Separator Membrane. The nitrogen separator membrane shall separate oxygen molecules from the incoming compressed air, and shall discharge sufficient

98% pure nitrogen from its outlet to maintain a minimum 98% nitrogen purity within the sprinkler system piping.

e. Bypass Valve. A single two-way bypass valve shall be factory-assembled inside the enclosure.

i. NORMAL mode: This mode sends the dried, filtered compressed air to the nitrogen separator membrane, resulting in 98% pure nitrogen being sent to the sprinkler system piping.

ii. BYPASS mode: This mode sends the dried compressed air directly to the assembly outlet, bypassing the nitrogen separator membrane.

f. Nitrogen Generator Cabinet. The system nitrogen generator cabinet shall be a 14 gauge steel enclosure, powder coated red inside and out, with door attached by lif-off gauge hinges. The cabinet shall also contain a metering valve, two (2) pressure gauges, a drain valve and all required connections for testing and maintenance, and shall be equipped with a minimum 2 inch diameter red flashing LED beacon mounted on the top surface for 360 degree visibility. The beacon shall be activated when the assembly is in bypass (providing air) mode.

2. Nitrogen Receiver. The system shall be equipped with a nitrogen receiver with a capacity of 5 gallons. The nitrogen receiver shall be ASME code compliant, rated for 200 PSIG, and shall be equipped with a safety relief valve.

3. Purge Vent Assembly. The preaction sprinkler system piping shall be equipped with at least one purge vent assembly. The purge vent assembly shall be equipped with a manually-operated isolation ball valve, strainer, float valve that closes when sprinkler water reaches the device, fixed restriction orifice, and nitrogen purity analyzer port. The purge vent assembly shall permit purging of the sprinkler system piping per manufacturer recommendations, and monitoring of the nitrogen purity within the piping. At least one (1) purge vent assembly shall be provided per sprinkler system riser, refer to design drawings for vent assembly included in the cabinet in a packaged unit.

4. Automatic Purge and Nitrogen Concentration Display Device. The system shall be equipped with permanently installed automatic purge and nitrogen concentration display devices associated with each purge vent assembly.

a. The device shall use an advanced zirconium dioxide gas sensor, offering stable purity readings and long sensor life without the need for manual adjustment or calibration.

b. The device shall feature Automatic Drift Control (ADC™), an automatic analysis of gas sensor drift and application of correlation and gain offsets to maintain device accuracy regardless of sensor status. This analysis and drift control is routinely performed by algorithms built-in to the device control system each time the model automatically measures the nitrogen purity within the sprinkler piping. No user involvement or special reference gas shall be required

c. The device shall be in a steel enclosure, with field connection points for plenum-rated sampling tubing from the associated PVA, supply power, and volt-free signaling contacts.

d. The device's programmable logic controller shall have a display visible when the access door is closed. The display shall show the current nitrogen concentration in the pipe, the purge status, and the time and date.

e. Five (5) programmable buttons shall allow system function choices.

5. Nitrogen / Air Maintenance Device. Each preaction sprinkler riser shall be equipped with a nitrogen / air maintenance device, to properly regulate the nitrogen and air pressure to suit the valve installed in the riser. The device shall be designed specifically for use with nitrogen generation equipment, providing the accuracy, precision, repeatability, and flow necessary for the supply of nitrogen. The device shall be equipped with a high-precision adjustable regulator with a balanced design to minimize the effect of inlet pressure variation on outlet pressure and flow. The regulator shall have a large flow range and wide span, capable of consistent flow over a wide range of inlet pressures, without the need for multi-stage regulation. The regulator shall be adjusted at system commissioning to the pressure required by the preaction sprinkler valve. The device shall also be equipped with bypass valving for initial-fill in 30 minutes or less as required by NFPA 13. A pressure gauge, strainer, and backflow prevention device shall be part of the assembly.

6. Corrosion Monitor Assembly, The preaction sprinkler system piping shall be equipped with a corrosion monitor assembly, consisting of a precision-manufactured corrosion coupon, a pressure switch that will sense supervisory pressure when the corrosion coupon is perforated by corrosion, a shutoff ball valve, and a bleed valve.

7. Hand-Held Nitrogen Purity Analyzer. The system shall be supplied with a hand-held portable battery-operated nitrogen purity analyzer, to permit periodic verification of the purity of the nitrogen generator output. The analyzer shall have a digital display, showing the nitrogen purity in percent (measurement range 0 to 99.9%) with a 0.1% resolution. Flexible tubing shall connect the body of the analyzer to a female quick-connect fitting, compatible with the male quick-connect fitting located in the nitrogen generator cabinet. Proper performance of the nitrogen generation system shall be established with readings taken with the analyzer.

2.2 PIPE, FITTINGS, AND SPECIALTY

A. General Requirements. Comply with requirements in "Piping Schedule" article and on contract drawings for applications of pipe and fitting materials and joining methods.

B. Pipe.

1. All pipe shall be black steel. Galvanized pipe shall not be permitted.

2. All pipe shall be minimum Schedule 40. Schedule 10 pipe shall not be permitted.

3. All threads shall be NPT.

C. Fittings and Couplings.

1. All fittings shall be black or factory-painted steel. Galvanized fittings shall not be permitted.

2. Fittings and couplings shall be minimum Class 150.

3. Grooved Joint Fittings. AWWA C606 and UL 213C; provide products by one or more of the following manufacturers, subject to compliance with requirements:

a. Victaulic,

b. Anvil International, Inc. (Gruvlock),

c. Star Corporation,

d. Or approved equal.

4. Grooved-Joint Couplings. AWWA C606, UL 213, and UL 213C, rigid pattern, unless otherwise indicated. Include steel housing sections, EDPM rubber gasket, B18.2.1 carbon steel bolts, and nuts.

D. Unions.

1. Unions shall be black malleable or ductile iron, or steel. Galvanized unions shall not be permitted.

2. Unions shall be used only as necessary where joining pipe is impossible or impractical without them.

E. Hangers.

1. Design, provide, fabricate, and install all hangers and supports adequate to support pipe, allow for imposed forces, satisfy structural requirements, and maintain proper clearances to adjacent piping, equipment, and structural elements.

2. Hangers and supports shall keep piping in alignment without sagging or interference.

2.3 Fire Detection Design.

1. Standards.

a. FM Property Loss Prevention Sheet 5-40 – Fire Alarm Systems.

b. FM Number 3010 – Fire Alarm Signaling Systems.

c. NFPA 70 – National Electrical Code.

d. NFPA 72 – National Fire Alarm Code.

2. Requirements.

a. Power.

i Primary. Primary power shall be from a 120 VAC 60 Hz single-phase dedicated branch circuit. A primary power calculation that details the power requirements for the Kidde Aries-SLX control panel and all field devices such as smoke detectors, notification appliances and releasing solenoids shall be performed.

ii Standby. Standby power shall be provided by rechargeable gel-cell batteries installed in the PREACTION-PAC™ electrical enclosure. A secondary power calculation that shows the quiescent and alarm power requirements for the Kidde Aries-SLX control panel and all field devices shall be performed.

1. Quiescent power requirement = 24 hours.

2. Alarm power requirement = 5 minutes.

b. Wire Sizes. Voltage drop calculations shall be performed justifying the wire sizes of all 24 VDC circuits.

C. System Operation - Double Interlock

1. Both an alarm signal from the separate fire detection control panel AND the activation by heat of an automatic sprinkler head are necessary to cause water to discharge.
2. An alarm signal from the separate fire detection control panel BEFORE activation by heat of an automatic sprinkler head shall NOT allow water to enter the sprinkler piping.
3. The activation by heat of an automatic sprinkler head AFTER an alarm signal from the separate fire detection control panel shall:
   a. Sense the pressure loss in the system piping through the actuation of a pneumatic actuator (known as “pneumatic –electric release”). Systems which sense system piping pressure loss through actuation of an electric low pressure switch (known as “electric-electric release’) are NOT acceptable and will not be considered equal.
   b. Allow water to enter the sprinkler piping.
   c. Discharge water from activated sprinkler heads.
4. The activation by heat of an automatic sprinkler head OR a break or air leak in the sprinkler piping BEFORE an alarm signal from the separate fire detection control panel shall NOT allow water to enter the sprinkler piping.
5. Operation of the emergency manual release valve integral with the PREACTION-PAC™ shall open the preaction valve and allow water to enter the sprinkler piping.

PART 3 – EXECUTION

3.1 PIPING INSTALLATION

A. Location and Arrangement. Contract drawings, plans, schematics, and diagrams indicate general location and arrangement of piping. Working drawings shall indicate actual piping installation layout. Install piping per working drawings.

B. Deviations. Installation deviations from approved working drawings require written approval from the Engineer. During installation, do not deviate from approved working drawings without written approval from the Engineer.

C. Fittings. Use listed fittings to make changes in direction and pipe size reductions.

D. Pipe Ends. Ream ends of pipe to remove burrs. Bevel plain ends of pipe.

E. Examination. Examine all pipe and fittings thoroughly before installation. Do not install damaged or defective pipe or fittings.

F. Cleaning. Remove scale, slag, dirt, oil, cutting and threading shavings, and debris from inside and outside of pipe after fabrication and before assembly. Use a non-toxic solvent to ensure pipe is clean. Pipe shall be free of solvent and water when installed.

G. Sleeves.

1. Install sleeves where piping penetrates walls, ceilings, and floors.

2. Install sleeve seals for piping penetrations of concrete walls and slabs.

3. Install escutcheons at all penetrations.

4. Comply with requirements for sleeves, sleeve seals, and escutcheons in Division 21 section “Sleeves, Sleeve Seals, and Escutcheons for Fire Suppression Piping.”

3.2 ELECTRICAL INSTALLATION

A. Location and Arrangement. Contract drawings, plans, schematics, and diagrams indicate general location and arrangement of electrical devices. Working drawings shall indicate actual device installation layout. Install devices per working drawings.

B. Deviations. Installation deviations from approved working drawings require written approval from the Engineer. During installation, do not deviate from approved working drawings without written approval from the Engineer.

C. Wiring.

1. All wiring shall be of the proper size to conduct the circuit current, but shall not be smaller than #18 AWG unless permitted by the local electrical code.

2. Wire that has scrapes, nicks, gouges, or crushed insulation shall not be used.

3. The manufacturer's minimum wire-bending radii shall be observed in all enclosures, raceways, and conduits.

4. Aluminum wire shall not be used.

5. Splicing of circuits shall be kept to a minimum, and is only permitted in an electrical box suitable for the purpose. Appropriate hardware shall be used to make the wire splices. Wires that are spliced together shall have the same color insulation.

6. Wire with white insulation shall be used exclusively for the identification of the neutral conductor of AC circuits. Wire with green insulation shall be used exclusively for the identification of the earth-ground conductor of AC or DC circuits. Appropriate color-coding shall be utilized for all other field wiring.

7. All electrical circuits shall be numerically tagged with suitable markings at each terminal point. All circuits shall correspond with the installation drawings.

D. Raceways.

1. Wiring to be installed in a minimum ¾ inch EMT or equivalent flexible conduit using steel compression fittings.

2. All electrical enclosures, raceways, and conduits shall be provided and installed in accordance with applicable codes and intended use, and shall contain only those electrical circuits associated with the nitrogen-generating system. No circuit or circuits that are unrelated to the nitrogen-generating system shall be routed through the enclosures, raceways, and conduits dedicated to the nitrogen-generating system.

3.3 TESTING AND COMMISSIONING

A. Testing and commissioning to be performed by the installing licensed sprinkler contractor in accordance with manufacturer's commissioning instructions, using manufacturer-supplied instruction manuals and checklists.

B. Test And Commissioning Plan.

1. The Contractor shall submit a test and commissioning plan that describes how the system shall be tested and commissioned. This shall include a step-by-step description of all tests and shall indicate type and location of test apparatus to be used. At a minimum, the tests to be conducted shall be per the relevant referenced codes, any additional supplemental tests required by the authority having jurisdiction, and the nitrogen system manufacturer's commissioning instructions.

2. Tests shall not be scheduled or conducted until the Engineer approves the test and commissioning plan.

C. Execution. All tests shall be performed in the presence of the Engineer and the authority having jurisdiction. The Contractor shall record all equipment, tests and system configurations in a format approved by the Engineer and the authority having jurisdiction. A copy of the commissioning tests and results shall be provided to the Engineer, the authority having jurisdiction, and the end user.

D. Commissioning. The commissioning process shall include at least the following steps:

1. Verify that all aspects of the installation have been completed, including:

   a. Device location and mounting.

   b. Mechanical interconnection.

   c. Electrical installation.

2. Perform an air pressure leakage test on each preaction sprinkler piping network. Sprinkler piping leakage rate shall not exceed NFPA 13 acceptance requirement of maximum 1-1/2 PSIG leakage in 24 hours starting at 40 PSIG. Correct leaks on systems exceeding this leakage until requirement is met.

3. Adjust regulators on each nitrogen / air maintenance device to indicate normal value (from shop drawings) on pressure gauges.

4. Perform initial-fill of each preaction sprinkler piping network with air from compressor with nitrogen system in bypass mode. Each network shall fill in 30 minutes or less. If any network fails to fill in 30 minutes, contractor shall make corrections before proceeding.

5. Restore all valves to normal (not initial-fill or bypass) status.

6. Measure output nitrogen purity of nitrogen generator with hand-held nitrogen purity analyzer. Record measured value. If recorded value is less than 98%, contractor shall follow manufacturer's instructions for correction before proceeding.

7. Open valves on each purge vent assembly.

8. Verify that each TRUE ADVANCED PURGE™ with ADC™ device is operating, and is indicating present nitrogen purity in each sprinkler piping network.

9. Operate Purge function on TRUE ADVANCED PURGE™ with ADC™ device(s) in the pre-determined sequence shown on the shop drawings.

10. Record values shown on each pressure gauge, including:

    a. Two (2) pressure gauges in nitrogen generator cabinet (upstream and downstream of nitrogen separator membrane.)

    b. Pressure gauge(s) indicating pressure on each nitrogen / air maintenance device.

11. The contractor shall return at regular, agreed-to intervals to continue the purging process until all sprinkler piping networks read at least 98% nitrogen purity at each TRUE ADVANCED PURGE™ with ADC™ device.

3.4 WARRANTY

A. All equipment and installation to be warranted against defects for 24 months starting upon the date of system acceptance by all authorities having jurisdiction.

SECTION 22 05 00
COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 22.

B. Motors shall comply with Division 23 Section - “Common Motor Requirements”.

C. Variable Frequency Drives shall comply with Division 23 Section - “Variable Frequency Drives”.

1.2 SUMMARY

A. Section includes:

1. General administrative and procedural requirements, as well as the following basic plumbing materials and methods.
2. Submittals.
3. Coordination drawings.
4. Record documents.
5. Operation and Maintenance manuals.
6. Rough-ins.
7. Plumbing installations.
8. Cutting and patching.
9. Concrete equipment base construction requirements.
10. Equipment nameplate data requirement.
11. Labeling and identifying mechanical systems and equipment is specified in Division 22 Section “Identification for Plumbing Piping and Equipment.”
12. Non-shrink grout for equipment installations.
13. Installation requirements common to equipment specification Sections.
14. Touchup painting and finishing.

1.3 ACRONYMS

A. The following list of abbreviations are utilized within the specifications and are provided as a reference:

1. ADA - American Disability Act
2. ANSI - American National Standards Institute
3. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
4. ASME - American Society of Mechanical Engineers
5. ASTM - American Society for Testing and Materials
6. AWS - American Welding Society
7. AWWA - American Water Works Association
8. IBC - International Building Code

9. CS - Commercial Standard
10. CSA - Canadian Standards Association
11. IEEE - Institute of Electrical and Electronics Engineers
12. IMC - International Mechanical Code
13. IPC - International Plumbing Code
14. MOSHA - Maryland Occupational Safety and Health Administration
15. MSSP - Manufacturers Standards Society of the Valve and Fittings Industry
16. NEC - National Electrical Code
17. NEMA - National Electrical Manufacturers Association
18. NFPA - National Fire Protection Association
19. OSHA - Occupational Safety and Health Administration
20. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
21. UL - Underwriters' Laboratories

1.4 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term product includes the terms material, equipment, system, and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Substitutions: Changes proposed by Contractor in products, materials, equipment, and methods of construction required by the Contract Documents.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named, or a product is accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

E. Extended Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.5 SYSTEM DESCRIPTION

A. Design Requirements: Contract drawings are generally diagrammatic and do not indicate all offsets, fittings, transitions, access panels and other specialties required.

1. Furnish and install all items as may be required at no additional cost to fit the work to the conditions encountered.
2. Arrange piping, equipment and other work generally as shown on the contract drawings, providing proper clearances and access.
3. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawing submittal for approval in accordance with Submittals specified below.
4. Subject to the provisions of Division 01, Architect may make reasonable changes in location of equipment piping and ductwork up to the time of rough-in or fabrication.

1.6 SUBMITTALS

A. Division 01 Section: “Submittal Procedures”: Submittal Procedures.

B. Shop Drawings and Product Data:

1. Clearly identify all submittals:

a. Indicate intended application, location, etc.
b. Each submittal shall indicate the associated specification section, and paragraphs. Do not combine product data and shop drawing submittals from different spec sections into a single submittal package, even though they may be the same distributor, vendor or part of a single material order.
c. Clearly indicate the exact type, model number, size and special features of the proposed item.
d. Include catalog spec sheets to completely describe proposed equipment.
e. Factory order forms only showing the required capacities are not acceptable.
f. Identify all options furnished to meet specifications.
g. If product is within system supplying fixture intended to dispense potable water for human consumption, including drinking and cooling, submittals shall indicate that product is “lead free”, containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.
h. Solder and flux for soldered joints in potable water piping shall be “lead free”, containing not more than 0.2% lead.
i. The Architect shall not select equipment ratings and/or options. Submittals not properly marked shall be returned without review.
j. Comply with VOC limitations under section 099100.

C. Comparable Products Submission:

1. Document each request for a proposed comparable product with supporting data substantiating compliance of proposed product with Basis-of-Design product.
2. Use the attached “Comparable Product Submittal Form” in addition to the requirements specified herein.
3. Comparable products will not be reviewed without completion of the attached form.

D. Coordination Drawings:

1. Building Information Model (BIM):

    a. Coordination drawings shall be created from 3D BIM model of all Mechanical, Electrical, Fire Protection, and Plumbing systems. Assign an individual to serve as the main point of contact for the BIM related issues. This individual shall have sufficient BIM experience required for the size and complexity of the project and shall have relevant proficiency in the BIM process.
    b. Coordinate construction sequencing and scheduling activities and assure they are integrated with the BIM documents.
    c. All design modifications in the field, RFI Responses, Submittals, and Owner requested changes shall be documented and updated in the BIM documents in a timely manner.
    d. All coordination efforts and BIM updates shall be provided without changes to the contract cost and/or schedule.

2. Prepare coordination drawings to a scale of ¼”=1’0” or larger, detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components.

3. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work, including (but not necessarily limited to) the following:

    a. The proposed locations of piping, valving, ductwork, equipment, and materials.
    b. Planned piping layout, including valve and specialty locations and valve stem movement.
    c. Planned duct systems layout, including elbow radii and duct accessories.
    d. Clearances for installing and maintaining insulation.
    e. Clearances for serving and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
    f. Equipment connections and support details.
    g. Exterior wall and foundation penetrations.
    h. Fire-rated wall and floor penetrations.
    i. Sizes and location of required concrete pads and bases.
    j. Duct fire dampers.
    k. Access doors.
    l. Clearances at electrical components in accordance with the National Electrical Code.
    m. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
    n. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations. Show all wall mounted access doors for devices in ductwork or piping.
    o. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets light fixtures, communication systems components, cable trays, sprinklers, access doors and other ceiling mounted items.

E. Closeout Submittals:

1. Record Drawings: Prepare record documents in accordance with the requirements in Division 01 Section: "Execution and Closeout Requirements” In addition to the requirements specified in Division 01, indicate the following installed conditions:

a. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 22 Section: “Identification for Plumbing Piping and Equipment". Indicate actual inverts and horizontal locations of underground piping.
b. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
c. Approved substitutions, Contract Modifications, Responses to Contractor’s Request for Information, and actual equipment and materials installed.
d. Record the locations and invert elevations of underground installations.

2. Operation and Maintenance Data: Prepare operation and maintenance data in accordance with Division 01 Section: "Execution and Closeout Requirements". In addition to the requirements specified in Division 01, include the following information for equipment items:

a. List of systems and equipment requiring service manuals.
b. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
c. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
d. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
e. Servicing instructions and lubrication charts and schedules.
f. Systems and Equipment test reports.

3. Commissioning Report

F. Color Selection: Color of finishes shall be as selected by the Architect. Submit colors of factory finished equipment for acceptance prior to ordering.

G. Products and Materials:

1. Submit complete descriptive data for all materials as follows:

a. Material specifications.
b. Data sheets.
c. Samples.
d. Capacity ratings.
e. Performance curves.
f. Operating characteristics.
g. Catalog cuts.
h. Dimensional drawings.
i. Wiring diagrams.
j. Lead Free, for potable water service.
k. Installation instruction.
l. Any other information necessary to indicate compliance with contract documents.

2. Edit submittal data specifically for application to this project.
3. Submit actual operating conditions and characteristics for all equipment.
4. Catalogs or catalog cuts are not acceptable unless the particular item and all relative data has been marked in such a manner as to be clearly defined.
5. Color of finishes shall be as selected by the Architect. Submit colors of factory finished equipment for acceptance prior to ordering.

6. No plumbing item shall be fabricated, purchased, delivered to the site or installed, until reviewed by the Architect.

    a. After the proposed materials have been approved, no substitution will be permitted except where approved by the Architect.
7. Provide shop drawing and product data submittals as indicated under individual specification sections.
8. Provide any other equipment requested by the Architect.

H. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.7 QUALITY ASSURANCE

A. Underwriter's Laboratory (UL) Requirements: All equipment containing electrical components and provided under Division 22 shall bear the Underwriter's Laboratory (UL) label, as a complete packaged system.

1. Equipment not provided with a UL label shall be tested in the field, certified and provided with a listed label at the installer's expense.

    a. Field testing shall be performed by a testing agency approved by the authority having jurisdiction.
    b. Provide services of a UL recognized, independent Electrical Testing Laboratory (ETL) to provide field inspection and testing. Provide and ETL Label on all such equipment.

B. Fire Safe Materials: Unless otherwise indicated, materials shall conform to UL, National Fire Protection Agency (NFPA) or American Society for Testing and Materials (ASTM) standards for fire safety with smoke and fire hazard rating not exceeding flame spread of 25 and smoke developed of 50.

C. All plumbing products and materials shall be listed by a third party certification agency.

1. Each length of pipe and each pipe fitting, trap, fixture, material and device utilized in a plumbing system shall bear the identification of the manufacturer and any markings required by the applicable referenced standards.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section: "Product Requirements:"

1. Deliver, store, and handle products according to manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
2. Schedule delivery to minimize long-term storage at Project Site and to prevent overcrowding of construction spaces.
3. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

4. Deliver products to Project Site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
5. Inspect products upon delivery to ensure compliance with Contract Documents and to ensure that products are undamaged and properly protected.
6. Store products in manner that will facilitate inspection and measurement.
7. Store materials in a manner that will not endanger project structure.
8. Store products subject to damage by elements above ground, under cover in a weather tight enclosure, with ventilation adequate to prevent condensation.
9. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather protection requirements for storage.

1.9 SEQUENCING

A. Coordinate plumbing equipment installation with other building components.

B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for plumbing installations.

C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.

E. Coordinate connection of electrical services.

F. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

G. Coordinate requirements for access panels and doors where plumbing items requiring access are concealed behind finished surfaces.

H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

1.10 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include project-specific information and properly executed.

2. Refer to Divisions 01 through 26 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section: “Execution and Closeout Procedures.”

1.11 DISCREPANCIES

A. Where discrepancies occur between the drawings and specifications or within either document itself, the item or arrangement of better quality, greater quantity or higher cost shall be included in the contract price. The Architect shall decide on the item and manner in which the work shall be provided, based on the design intent of the documents.

1.12 ELECTRONIC CAD DOCUMENTS

A. Requests for electronic CAD documents will be accommodated to the contractors and installers upon their completion of Bowman’s Electronic Document Release of Liability Form.

1.13 SPECIAL TOOLS & OPERATING ACCESSORIES

A. Wherever any products provided under this Division have tamperproof, special or restrictive hardware, as specified or where provided from the manufacturer as standard or optional construction, provide a minimum of two (2) matching tools, bits, sockets, etc. needed for operation and/or access to such items. This shall include, but is not limited to:

1. Tamperproof screws, bolts, etc. on devices, enclosures, covers, etc.
2. Penta-head bolts used on handhole and/or manhole lids.
3. Penta-head bolts used on switchgear, transformers, etc.
4. Any other special tools which are unique to that product.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with Contract Documents that are undamaged and new at time of installation.

1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for complete installation and intended use and effect.
2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Where products are accompanied by the term as selected, Architect will make selection.
4. Where products are accompanied by the term match sample, sample to be matched is Architect's.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. General Compliance Requirements: Compliance requirements for individual products, as indicated in Contract Documents, are multiple in nature and may include generic descriptions, performance requirements, compliance with reference standards, conformance with graphic details and other similar forms and methods of indicating requirements, all of which must be complied with.

C. Procedures for Selecting Products: Contractor's options for selecting products are limited by Contract Document requirements, and are not controlled by industry traditions or procedures experienced by Contractor on previous construction projects.

D. Products specified by Reference Standards, Codes and Regulations: Select from among products, which can be shown to comply with referenced documents.

E. Products specified by Naming Products and Manufacturers: Select from among products listed.

F. Products specified by Naming One Manufacturer's Product as the Basis-of-Design with Reference to Other Manufacturers: Select either the specified Basis-of-Design product or an approved comparable product by one of the other named manufacturers.

1. Comply with provisions in Comparable Products Article to obtain approval for use of a comparable product by one of the named manufacturers.

G. Products specified by Naming One Manufacturer's Product and Indicating Option of Selecting Comparable Products by stating or Approved Equivalent or similar language: Select either the specified product or an approved comparable product.

1. Comply with provisions in Comparable Products Article to obtain approval for use of a comparable product by one of the named or un-named manufacturers.

H. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and, matches Architect's sample. Architect's decision will be final on whether proposed product matches satisfactorily.

I. Visual Selection Specification: Where Specifications include the phrase as selected from manufacturer's standard colors, patterns, textures or similar phrase, select a product that complies with other specified requirements. Architect will select color, pattern, and texture.

1. Standard Range: Where Specifications include the phrase standard range of colors, patterns, textures or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
2. Full Range: Where Specifications include the phrase full range of colors, patterns, textures or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Where Basis-of-Design products are specified by name, submit the following, in addition to other required submittals, to obtain approval of a comparable product by one of the named manufacturers:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with the Basis-of-Design product in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, serviceability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

2.3 GROUT

A. Non-shrink, Nonmetallic Grout: ASTM C 1107, Grade B, “Packaged Dry, Hydraulic-Cement Grout (Nonshrink)”, “latest edition”.

1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory-packaged.

2.4 ACCESS DOORS AND PANELS

A. Provide manufactured steel door assemblies consisting of:

1. Hinged door.
2. Flush screwdriver camlocks and frame.

B. Doors shall be Milcor Metal Access doors. Provide key locks where indicated.

C. Design shall be provided for the following installations:

1. Masonry or Dry Wall: Style M.
2. Suspended ceilings: Style CT.
3. Security: Style 3211.

PART 3 - EXECUTION

3.1 PREPARATION

A. Interface With Site Utility Companies:

1. Contact MISS UTILITY prior to any excavation or underground work.
2. Contact local utility companies (water, sewer, etc.) immediately upon award of contract. Do not install related equipment until fully coordinated with appropriate utilities.
3. Provide all construction schedules, dates of requested services, outage windows, equipment locations, etc. necessary for utility work.

4. Water and Sewer Utilities:

   a. Coordinate flow, usage and pressure requirements with local water and sewer authorities as necessary to obtain services.

3.2 BUILDING INFORMATION MODEL (BIM) COORDINATION DRAWINGS

A. The contract drawings are diagrammatic and do not indicate every component and duct/piping offset fittings required for a complete installation. Incorporate all necessary and required components and routing modifications to ensure that all systems are coordinated and in compliance with specified ceiling heights wall thinness, building structure, etc.

B. It is the contractor's responsibility to conduct and manage an adequate and thorough BIM and conduct a clash detection process so that all major interferences between building components have been detected and resolved before fabrication and installation of systems. The contractor shall assemble a composite BIM for each subcontractor's BIM. Vertical shafts shall also be reviewed to ensure that adequate space has been allocated for all of the vertical mechanical systems and that all of the shafts lie up floor to floor.

C. All coordination efforts and BIM updates shall be provided without changes to the contract cost and/or schedule. The accuracy of the BIM shall be verified by the contractor and approved, prior to submittal to the Architect for review.

D. Update BIM based on submittals, RFIs, or Owner directed changes and maintain the BIM based on construction activities. BIMs will be revised throughout construction, based on owner directives, revised contract documents, and As-Built conditions.

3.3 INSTALLATION

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where systems, materials and equipment are intended for overhead installation, and where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements

indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.

9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.
10. Install plumbing equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install access panel or doors where units or valves are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section: "Access Doors and Frames" and within this section.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

B. Rough-In

1. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
2. Refer to equipment specifications in Divisions 01 through 26 for rough-in requirements.

C. Housekeeping and Equipment Pad

1. Construct pads of dimensions indicated, but not less than 4 inches larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi,, 28-day compressive strength concrete and reinforcement bars as specified in Division 03 Section: "Cast-in-Place Concrete".

D. Erection of Metal Supports and Anchorage

1. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
2. Field Welding: Comply with AWS D1.1, "Structural Welding Code -Steel", 2001.

E. Erection of Wood Supports and Anchorage

1. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.
2. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
3. Attach to substrates as required to support applied loads.

F. Grouting

1. Install nonmetallic non-shrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.
2. Clean surfaces that will come into contact with grout.
3. Provide forms for placement of grout, as required.
4. Avoid air entrapment when placing grout.
5. Place grout to completely fill equipment bases.
6. Place grout on concrete bases to provide a smooth bearing surface for equipment.

7. Place grout around anchors.
8. Cure placed grout according to manufacturer's printed instructions.

G. Lintels

1. Lintels shall be provided for openings in masonry, brick, concrete, etc. walls to accommodate work of this division.

a. Lintels shall be provided under this division when not being provided under other divisions. Lintels shall be approved by the Architect.

3.4 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 01 Section: "Execution and Closeout Requirements". In addition to the requirements specified in Division 01, the following requirements apply:

1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of plumbing equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Remove samples of installed Work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Architect, uncover and restore Work to provide for Architect observation of concealed Work.

C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.5 PAINTING AND FINISHING

A. Division 09 Section: "Painting and Coating” for field painting requirements.

B. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Do not paint manufacturer's labels or tags.

3.6 CONSTRUCTION

A. Cutting, Welding, Burning

1. Before commencing any cutting, welding, burning, brazing (pipe sweating), obtain a hot work permit from Environmental Health and Safety.
2. The hot work permit copy shall remain on the job site at the hot work location until such work is completed at which time the permit shall be returned to Environmental Health and Safety.

3.7 PENETRATION OF WATERPROOF CONSTRUCTION

A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls and interior waterproof construction.

B. Furnish and install drains, curbs, vent assemblies, sleeves, flashing, etc. specifically designed for application to the particular construction. Install system in accordance with the roofing manufacturer's instructions.

3.8 EXCAVATION AND BACKFILLING

A. General

1. Perform all necessary excavation, for installation of work under Division 22, in accordance with Division 31.

3.9 CLEANING

A. Clean surfaces prior to application of insulation, adhesives, coating, and paint.

B. Provide factory applied finish where specified.

C. Protect all finishes, and restore all finishes to their original condition if damaged as a result of work under Division 22.

D. Remove all construction marking and writing from exposed equipment, ductwork, piping and building surfaces.

E. General: General cleaning during construction is required by the General Conditions and included in Section Temporary Facilities.

F. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

G. Remove all plumbing clipping, wiring, nuts, bolts, etc. left on top of ceilings and ceiling tiles.

3.10 PROTECTION

A. Protect work, material and equipment from weather and construction operations before and after installation.

B. Properly store and handle all materials and equipment.

C. Cover temporary openings in piping, ductwork and equipment to prevent the entrance of water, dirt, debris, and other foreign matter.

3.11 LUBRICATION

A. All bearings, motors and all equipment requiring lubrication shall be provided with accessible fittings.

B. Before turning over the equipment to the Owner, provide the following:

1. Fully lubricate each item of equipment.
2. Provide 1 year's supply of lubricant for each type of lubricant.
3. Provide complete written lubricating instructions, together with diagram locating the points requiring lubrication.

C. Motors and equipment shall be provided with grease lubricated roller or ball bearings with Alemite or equal extended grease fittings and drain plugs.

3.12 ELECTRICAL WORK

A. It is the intent to provide a complete and operational system. The work between Division 22 and 26 is complementary and is meant to produce a single and operating system. Contractor shall make its own determination as to the distribution of responsibility among the various trades.

B. All electrical work performed under Division 22 shall be provided in accordance with Division 26.

3.13 PROVISIONS FOR ACCESS

A. Furnish and install adequate access to all plumbing components. The following list shall be used as a guide only:

1. Plumbing equipment.
2. Valves.
3. Cleanouts.
4. Traps.

B. Access shall be adequate as determined by the Architect.

C. Refer to contract drawings where panels have been specifically located.

D. Provide additional panels for adequate access as indicated in paragraph A above.

E. Where access is by means of liftout ceiling tiles or panels mark each panel using small color-coded or numbered tabs. Provide an index chart for identification. Place markers in corner of tile.

3.14 OPERATION OF EQUIPMENT

A. Clean all systems and equipment prior to initial operation for testing and balancing.

B. Do not operate equipment unless all proper safety devices or controls are operational.

C. Provide all maintenance and service for equipment, which is operated during construction.

D. Where specified and otherwise required, provide the services of a manufacturer's factory trained service organization to start the equipment.

E. Do not use mechanical systems for temporary services during construction unless authorized in writing by the Architect.

1. Where such authorization is granted, temporary use of equipment shall not limit or otherwise affect warranties or guarantees of the work.

F. Upon completion of work, clean and restore all equipment to new conditions and replace all filters.

3.15 DEMONSTRATION

A. Demonstrate operation and maintenance of equipment and systems to Owner’s personnel a minimum two (2) weeks prior to date of final inspection.

1. For equipment requiring seasonal operation, perform instructions for other seasons at the same time.
2. Training period shall be performed within 1 - two week period.

B. Use operation and maintenance manuals and video as basis of instruction. Review contents of manual and video with personnel in detail to explain all aspects of operation and maintenance.

C. Demonstrate the following:

1. Start up.
2. Operation.
3. Control.
4. Adjustment.
5. Trouble shooting.
6. Servicing.
7. Maintenance.
8. Shutdown.

D. Provide at least 40 hours straight time instruction to the operating personnel.

1. This instruction period shall consist of not less than five-8 hour days.
2. Time of instruction shall be designated by the Owner.

3. This instruction shall be in addition to instructional requirements of specific equipment specified elsewhere in Division 22.

3.16 WALL AND FLOOR PENETRATION

A. All penetrations of partitions, walls and floors by ducts, piping or conduit under Division 22 shall be sealed and caulked. Provide U.L. listed fire stopping systems at penetrations through fire rated walls.

B. Sealing of Annular Spaces at Penetrations.

1. The annular spaces between the outside of a pipe and the inside of a pipe sleeves, or between the outside of a pipe and an opening in a building envelope wall, floor, or ceiling assembly penetrated by a pipe shall be sealed in an approved manner with caulking material or closed with a gasketing system. The caulking material, foam sealant, or gasketing system shall be designed for the conditions at the penetration location and shall be compatible with the pipe, sleeve and building materials in contact with the sealing materials. Annular spaces created by pipes penetrating fire resistance-rated assemblies or membranes of such assemblies shall be sealed or closed in accordance with the International Building Code.

3.17 EQUIPMENT PROVIDED UNDER ANOTHER DIVISION AND BY OTHERS

A. Make all system connections required to equipment furnished and installed under another division and by others.

B. It shall be the responsibility of the Contractor to coordinate all necessary data from the equipment supplied under other Divisions.

3.18 MECHANICAL EQUIPMENT SERVICE PLATFORMS

A. Where mechanical equipment is located on a roof or elevated structure that requires access such that personnel will have to climb over ductwork or higher than 16 feet above grade to access the equipment, a means to access the equipment shall be provided.

B. Provide catwalks around the entire perimeter of equipment to match manufacturer required clearance area. Minimum 36” from perimeter of unit.

C. Provide side edge railings that extend above the catwalk not less than 30” above the catwalk.

3.19 PROJECT PUNCH OUT

A. Architect/Engineer will perform punch out reviews and will provide the Contractor with a list of punch list items to be completed before contract close out. Each and every punch list item shall be initialed and dated by the Contractor when the work is complete. The Architect/ Engineer will not perform any punch list verification until all items have been completed, initialed, dated and the list returned to the Architect/Engineer. If any items have been initialed as being completed

by the Contractor and the Architect/Engineer determines that the work is not complete, the Architect/Engineer shall be reimbursed by the Contractor at his regular hourly rate for any and all items requiring revisiting of the site by the Architect/Engineer. Reimbursement will be made by deducting the Architect/Engineer fee from the Contractor's final payment.

3.20 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section “Commissioning”.

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable.

COMPARABLE PRODUCT SUBMITTAL FORM

Table of Compliance (Sample)
Shop Drawing and Product Data Submittal

The Contractor shall prepare a Table of Compliance Form similar in format to the sample shown below to facilitate and expedite the Shop Drawing and Product Data Review. Failure to comply with this requirement will be basis for rejecting the Submittal.

The Table of Compliance Form will list and compare the performance parameters as the submitted equipment to that listed on equipment schedule and specifications as basis of design. All non-compliance items (differences) must be explained in full, indicating their impact, if any, on maintainability, durability, energy use, operating costs, code compliance and environmental considerations.

(Sample)

TABLE OF COMPLIANCE

EQUIPMENT: _____ SPEC. SECTION: _____

BASIS OF DESIGN SAMPLE ITEMS	DRAWINGS	SUBMITTED	EXPLANATION
Flow (Cfm Or Gpm)			
Ext. Static Press.			
Head (Ft.)			
Electrical Requirements			
Cooling Capacity			
Heating Capacity			
Discharge Air Temp.			
Filter Type & Eff.			

Equipment Eff. (Eer)			
Sound Data			
Weights			
Etc.			
Specifications:			
A. Quality assurance compliance (ARI)			
(ASHRAE)			
(AMCA)			
(UL)			
B. Specifications: List each and every specification paragraph			
C. Etc.			
Other:			

END OF SECTION

SECTION 22 05 03
PIPES AND TUBES FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, and all sections of Division 22.

1.2 SUMMARY

A. Section includes:

A. Domestic Cold, Hot, and Circulating Hot Water (Potable and Non-Potable)
B. Sanitary, Sanitary Vent, and Storm Water
C. Sanitary and Storm Water Sumps and Ejectors Pressure Discharge Piping
D. Air Conditioning Condensate, Equipment Drains, and Overflows
E. Foundation Drains
F. Fuel Oil
G. Underground Pipe Markers
H. Piping Specialties and Accessories.
I. Sleeve Penetration Systems
J. Leak detection and location system.

B. Related Sections: The following Sections contain requirements that relate to this Section:

A. Division 03 Section: “Cast-In-Place Concrete”: Product and execution requirements for formwork, reinforcement, and concrete specified by this section.
B. Division 07 Section: “Firestopping” – For Opening Protection: Product and execution requirements for penetration through fire rated construction, and smoke seal protection specified by the section.
C. Division 07 Section: “Sheet Metal Flashing and Trim: Product and execution requirements for custom fabricated roof and wall flashings and roof drainage systems.
D. Division 08 Section: “Access Doors and Frames” for project requirements for access doors for placement by this section.
E. Division 09 Section: “Painting and Coating”: Product and execution requirements for painting specified by this section.
F. Division 22 Section: “Common Work Results for Plumbing”: Product and execution requirements for common work results for plumbing for placement specified by this section.
G. Division 22 Section: “Hangers and Supports for Plumbing Piping and Equipment”: Product requirements for pipe hangers and supports for placement specified by this section.
H. Division 22 Section: “Plumbing Piping System Cleaning and Treatment”: Product and execution requirements for system cleaning and treatment specified by this section.

I. Division 22 Section: “Vibration and Seismic Controls for Plumbing Piping and Equipment”: Product requirements for vibration isolation for placement specified by this section.
J. Division 22 Section: “Plumbing Insulation”: Product requirements for piping insulation for placement specified by this section.
K. Division 22 Section: “General – Duty Valves for Plumbing Piping”: Product requirements for valves for placement specified by this section.
L. Division 23 Section: “Facility Fuel Storage Tanks”: Product and execution requirements for placement specified by this section.
M. Division 31 Section: “Soils for Earthwork”: Soils for backfill in trenches.
N. Division 31 Section: “Aggregates for Earthwork”: Aggregates for backfill in trenches.
O. Division 31 Section: “Excavation”: Product and execution requirements for excavation and backfill required by this section.
P. Division 31 Section: “Trenching”: Execution requirements for trenching for underground piping systems.
Q. Division 31 Section: “Fill”: Execution requirements for backfilling required by this section.

1.3 DEFINITIONS

A. Point of Delivery is the outlet of the service meter assembly, or the outlet of the service regular (service shutoff valve when no meter is provided).

B. Domestic Water Systems: A system conveying domestic potable or non-potable water, such as Cold Water, Hot Water, Hot Water circulating, etc.

C. Gravity Drainage Systems: A system of gravity fed effluent conveying storm water, sanitary, and laboratory acid waste, etc.

D. Fuel Oil Distribution Piping: Piping which conveys fuel oil from the point of delivery to the points of usage.

E. Lead Free:

A. The pipes, pipe fittings, plumbing fittings or fixtures in plumbing systems that are intended to dispense potable water for human consumption, including drinking and cooking, shall be “lead free”, containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.
B. Solder and flux for soldered joints in potable water piping shall be “lead free”, containing not more than 0.2% lead free.

F. CPVC Piping: Chlorinated Polyvinyl Chloride thermoplastic pipe is made by the chlorination of PVC resin and extruded into pipe that meets FBC chemical compatibility

1.4 REFERENCES

(Unless otherwise noted, references apply to "latest editions.")

A. ANSI (American National Standards Institute)

A. ANSI B16.39, Malleable Iron Threaded Pipe Unions.
B. ANSI/ASME B1.20.1, Pipe Threads, General Purpose (Inch).
C. ANSI/ASME B16.3, Malleable Iron Threaded Fittings.
D. ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings.
E. ANSI/ASME B16.21, Non-metallic Flat Gaskets for Pipe Flanges.
F. ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
G. ANSI/ASME B16.29, Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings (DWV).
H. ANSI/API 600, Bolted Bonnet Steel Gate Valves for Petroleum and Natural Gas Industries.
I. ANSI/AWS B2.1, Standard Specification for Welding Procedure and Performance Qualification.
J. ANSI/AWS D10.12, Guide for Welding Mild Steel Pipe.
K. ANSI/AWWA C104, American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
L. ANSI/AWWA C110, American National Standard for Ductile-Iron and Gray-Iron Fittings, 3in. Through 48in., for Water and Other Liquids.
M. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
N. ANSI/AWWA C151, American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
O. ANSI/AWWA C153, American National Standard for Ductile-Iron Compact Fittings, 3in. Through 24in., and 54in. Through 64in, for Water Service.
P. ANSI / NSF Standard 14 Plastic Piping System Components and related.
Q. ANSI / NSF Standard 61 Drinking Water System Components – Health effects.
R. ANSI / UL 263 Standard for Safety for fire test of Building Construction and materials.
S. NSF/ANSI 14 – Plastic Piping System Components and related materials.
T. NSF/ASNI 14 – Plastic Piping System Components and related materials.
U. NSF 372 – Drinking Water System Components – Lead Content
V. ANSI/ASME B40.1 Pressure Gauges.
W. ANSI/ASME B40.2 Thermometers.

B. ASME (American Society of Mechanical Engineers)

A. ASME A112.1.2, Air Gaps in Plumbing Systems.
B. ASME A112.14.1, Back Water Valves.
C. ASME A112.21.2M, Roof Drains.
D. ASME A112.36.2M, Clean-outs.
E. ASME B16.5, Pipe Flanges and Flanged Fittings.
F. ASME B16.20, Metallic Gaskets for Pipe Flanges- Ring-Joint, Spiral-Wound, and Jacketed.
G. ASME B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
H. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
I. ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings.
J. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
K. ASME B18.2.1, Square and Hex Bolts and Screw- Inch Series.
L. ASME B18.10, Track Bolts and Nuts.

M. ASME B31.1, Power Piping.
N. ASME B31.9, Building Services Piping.
O. ASME B40.1, Gauges- Pressure Indicating Dial Type- Elastic Element.
P. ANSI/ASME B1.20.1, Pipe Threads, General Purpose (Inch).
Q. ANSI/ASME B16.3, Malleable Iron Threaded Fittings.
R. ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings.
S. ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
T. ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
U. ASME B16.25, Butt-Welding Ends.
V. ANSI/ASME B16.29, Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings (DWV).
W. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.
X. ANSI/AWA C606, Grooved and Soldered Joints.

C. ASSE (American Society of Sanitary Engineers)

A. ASSE 1001, Hose Connection Vacuum Breakers.
B. ASSE 1010, Water Hammer Arresters.
C. ASSE 1013, Reduced Pressure Principle Backflow Preventor.
D. ASSE 1015, Double Check Backflow Prevention Assembly.
E. ASSE 1016, Automatic compensating Valves for Individual Showers and Tub/Shower Combinations.
F. ASSE 1017, Temperature Actuating Mixing Valves for Hot Water Distribution Systems.
G. ASSE 1019, Vacuum Breaker Wall Hydrants, Frost Resistant Automatic Draining Type.
H. ASSE 1022, Dual Check with atmospheric port.
I. ASSE 1069, Automatic Temperature Control Mixing Valves.
J. ASSE 1070, Water Temperature Limiting Devices.
K. ASSE 1071, Temperature Actuated Mixing Valves for Plumbing Emergency Equipment.

D. ASTM (American Society for Testing and Materials)

A. ASTM A36, Standard Specification for Carbon Structural Steel.
B. ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
C. ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
D. ASTM A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
E. ASTM A182, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
F. ASTM A183, Standard Specification for Carbon Steel Track Bolts and Nuts.
G. ASTM A193, Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service.
H. ASTM A194, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
I. ASTM A216, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
J. ASTM A234, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High-Temperature Service.
K. ASTM A276, Standard Specification for Stainless Steel Bars and Shapes.
L. ASTM A278, Standard Specification for Gray Iron Castings for Pressure Containing Parts.

M. ASTM A351, Standard Specification for Stainless Steel Bars and Shapes.
N. ASTM A395 - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
O. ASTM A564, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
P. ASTM A582, Standard Specification for Free-Machining Stainless Steel Bars.
Q. ASTM A780, Standard Practice for Repair of Damaged and Un-coated Areas of Hot-Dip Galvanized Coatings.
R. ASTM B16, Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
S. ASTM B32, Standard Specification for Soldered Metal.
T. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
U. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
V. ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
W. ASTM B75 - Standard Specification for Seamless Copper Tube.
X. ASTM B88, Standard Specification for Seamless Copper Water Tubes.
Y. ASTM B124, Standard Specification for Copper and Copper Alloy Forging Rod, Bar and Shapes.
Z. ASTM B148, Standard Specification for Aluminum-Bronze Sand Castings.
AA. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
BB. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
CC. ASTM B302 - Standard Specification for Threadless Copper Pipe, Standard Sizes.
DD. ASTM B306, Standard Specification for Copper Drainage Tube (DWV).
EE. ASTM B819, Standard Specification for Seamless Copper Tube for Medical Gas Systems.
FF. ASTM B584, “Standard Specification for Copper Alloy Sand Castings for General Applications.
GG. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
HH. ASTM C33, Standard Specification for Concrete Aggregates.
II. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
JJ. ASTM C150, Standard Specification for Portland Cement.
KK. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
LL. ASTM C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrinking).
MM. ASTM D2321, Standard Practice for Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
NN. ASTM D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning Plastics in a Horizontal Position.
OO. ASTM D1784 – Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
PP. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
QQ. ASTM D2464, Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings.
RR. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
SS. ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
TT. ASTM D2564, Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

UU. ASTM D2665, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
VV. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
WW. ASTM D2729, Standard Specification for Poly (Vinyl Chloride) PVC) Sewer Pipe and Fittings.
XX. ASTM D2765, Test methods for determination of Gel Content and Swell Ration of Cross-Linked Ethylene Plastics.
YY. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
ZZ. ASTM D2996 - Standard Specification for Filament-Wound Fiberglass (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
AAA. ASTM D2997 - Standard Specification for Centrifugally Cast Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
BBB. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
CCC. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
DDD. ASTM D3262 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
EEE. ASTM D3517 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe.
FFF. ASTM D3754 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe.
GGG. ASTM D3840 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Nonpressure Applications.
HHH. ASTM D6394, Specification for Sulfone Plastics (SP).
III. ASTM E1, Standard Specification for ASTM Thermometers.
JJJ. ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
KKK. ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials.
LLL. ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
MMM. ASTM F402, Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners used for Joining Thermoplastic Pipes and Fittings.
NNN. ASTM F437 - Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
OOO. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
PPP. ASTM F439 - Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
QQQ. ASTM F441 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
RRR. ASTM F442 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).
SSS. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
TTT. ASTM F493, Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
UUU. ASTM F645 - Standard Guide for Selection, Design, and Installation of Thermoplastic Water- Pressure Piping Systems.
VVV. ASTM F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

WWW. ASTM F679 - Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
XXX. ASTM F844, Standard Specification for Washers, Steel, Plain (Flat), Unhardened for
YYY. ASTM F1476 – "Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications."
ZZZ. ASTM F1970 – Standard Specification for Special Engineered fittings, Appurtenances or Valves for use in Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Systems.
AAAA. ASTM F2618, Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Fittings for Chemical Waste Drainage Systems.

E. AWS (American Welding Society)

A. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
B. ANSI/AWS B2.1, Standard Specification for Welding Procedure and Performance Qualification.
C. AWS D1.1, Structural Welding Code- Steel.
D. ANSI/AWS D10.12, Guide for Welding Mild Steel Pipe.

F. AWWA (American Water Works Association)

A. AWWA C600, "Standards for Insulation of Ductile-Iron Water Mains and their Appurtances.
B. AWWA C700, "Standard for Cold-Water Meters- Displacement Type, Bronze Main Case.
C. AWWA C702, "Cold-Water Meters- Compound Type.
D. ANSI/AWWA C104, "American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
E. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
F. ANSI/AWWA C110, "American National Standard for Ductile-Iron and Gray-Iron Fittings, 3in. Through 48in., for Water and Other Liquids.
G. ANSI/AWWA C111, "Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
H. ANSI/AWWA C151, "American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
I. ANSI/AWWA C153, "American National Standard for Ductile-Iron Compact Fittings, 3in. Through 24in., and 54in. Through 64in, for Water Service.
J. ANSI/AWWA C606, "Grooved and Shouldered Joints.
K. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., for Water Distribution.

G. CS (Commercial Standard)

H. CSA (Canadian Standards Association)

I. IEEE (Institute of Electrical and Electronics Engineers)

J. IMC (International Mechanical Code)

K. IPC (International Plumbing Code)

L. Manufacturers Standardization Society of the Valve and Fittings Industry:

A. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
B. MSS SP 67 - Butterfly Valves.
C. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
D. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
E. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

M. MOSHA (Maryland Occupational Safety and Health Administration)

N. NEC (National Electrical Code)

O. NEMA (National Electrical Manufacturers Association)

P. NFPA (National Fire Protection Association)

A. NFPA 70, National Electrical Code.

Q. OSHA(Occupational Safety and Health Administration)

R. UL (Underwriters' Laboratories)

A. UL 273 – Standard for Test for Surface Burning Characteristics of Building Materials

1.5 SUBMITTALS

A. Division 01 Section: “Submittal Procedures”: Submittal Procedures.

B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, and sizes.

C. Maintenance data to be included in the operation and maintenance manual specified in Division 01. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing. Include data for the following:

A. Pipe Materials
B. Flow Measuring Systems
C. Plumbing Specialties

D. Project Record Documents: Record actual locations of piping mains with invert elevations, valves, manholes, and leak detection and location system.

E. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

F. Certification of compliance with ASTM, ASME and ANSI manufacturing requirements for pipe, fittings, and specialties.

G. Submit flange gasket bolt tightening sequence and torque requirements for review as part of gasket submittals.

H. Product Data: Submit data on each type of pipe material and fittings. Submit manufacturer's catalogue information.

I. Grooved joint couplings and fittings shall be shown on drawings and product submittals and shall be specifically identified with the applicable grooved system manufacturer's style or series number.

J. Welders' Certificate: Include welders' certification of compliance with AWS D1.1.

K. Fuel Piping Specialties: Submit manufacturer's catalog information including capacity, rough-in requirements, and service sizes.

L. Leak Detection and Location System: Submit manufacturer's catalog information for controller, alarm unit, and cable type.

M. CPVC Piping: Submit materials in contact with CPVC piping system that are compatible with CPVC compounds per FBC System Compatibility Program or consult product manufacturer

N. Comply with VOC limitations under section 099100.

O. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

B. Furnish shutoff valves complying with ASME B16.33 or ANSI Z21.15

C. Perform work in accordance with Authority Having Jurisdiction requirements

D. ASME (American Society of Mechanical Engineers) Compliance; comply with:

   A. ASME B31.9, Building Services Piping, latest edition.
   B. ASME B31.1, Power Piping, latest edition.

E. Qualify welding processes and welding operators according to AWS D1.1, Structural Welding Code—Steel, “latest edition”.

   A. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

F. Evaluate leak detection and location system by independent third party according to Third Party Procedures developed according to US EPS's "Standard Test Procedure for Evaluating Leak Detection Methods: Liquid-Phase Out-of-Tank Product Detectors." Evaluation results to verify system manufacturer's claim regarding sensitivity, range and other performance data.

G. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

   A. All castings used for coupling housings, fittings, valve bodies, etc…shall be date stamped for quality assurance and traceability.

H. Regulatory Requirements: Comply with the requirements of the following additional codes:

   A. International Mechanical Code (IMC).
   B. ANSI/ASHRAE Standard 15: Safety Code for Mechanical Refrigeration.
   C. PHCC - National Standard Plumbing Code, latest edition.
   D. NFPA 31, Standard for the Installation of Oil Burning Equipment for oil piping materials and components, oil piping installation, and inspection, and testing of fuel oil piping systems.
   E. HB 372 Business Occupations and Professions – Plumbers – Lead Free Materials.

I. CPVC Piping: Contractor should have received installation training from pipe/fitting manufacturer within two (2) years of start of this project for all CPVC piping systems.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years documented experience.

B. Leak Detection Systems: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

C. Installer: Company specializing in performing work of this section with minimum 5 years experience.

1.8 PRE-INSTALLATION MEETINGS

A. Division 01 Section: “Administrative Requirements”: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section: “Product Requirements”: Requirements for transporting, handling, storing, and protecting products.

B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

D. Handling Flammable Liquids: Remove and legally dispose of liquid from drips in existing gas piping and handle cautiously to avoid spillage or ignition. Notify the gas supplier. Handle flammable liquids used by the installer with proper precautions, and do not leave on the premises from the end of one working day to the beginning of the next.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section: “Product Requirements”: Environmental conditions affecting products on site.

B. Do not install underground piping when bedding is wet or frozen.

1.11 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.12 WARRANTY

A. Division 01 Section: “Execution and Closeout Requirements”: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for valves excluding packing.

C. Furnish five year manufacturer warranty for leak detection and location system.

1.13 COORDINATION

A. Division 01 Section: “Administrative Requirements”: Requirements for coordination.

B. Notification of Interruption of Service: Provide notification for all utility outages.

C. Work Interruptions: When interruptions in work occur while repairs or alterations are being made to an existing piping system, leave the system in safe condition.

D. Coordinate installation of buried piping with trenching.

E. Coordinate the installation of pipe sleeves for foundation wall penetrations.

F. Coordinate the size and location of concrete pads. Cast anchor bolt inserts into pad.

G. Coordinate the installation of roof piping support, and roof penetrations.

PART 2 - PRODUCTS

2.1 PIPE AND TUBE MATERIALS AND APPLICATION SCHEDULE

Domestic Cold, Hot, and Circulating Hot Water	**Pipe Material**	**Fitting Material**	**Joint Material**
(Below Grade)	4” and larger: Ductile Iron: AWWA C151 or with AWWA C104 cement mortar lining.	4” and Larger: Ductile Iron: AWWA C 110 or AWWA C153, with AWWA C104 cement mortar lining.	AWWA C111 rubber gasket with rods
	3” and smaller: ASTM B88, Type K, water tube, annealed temper.	ASME B16.18, cast copper, or ASME B16.22, wrought copper.	Brazed, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F
(Above Grade)	Copper Tube: ASTM B88, Type L, Seamless, Water Tube, hard-drawn temper.	Copper Tube: ASME B16.22, wrought copper, or copper alloy, solder joint, 150 lb.	ASTM B32, alloy Sb5 (95 percent tin and 5 percent antimony), lead free solder.
	Copper Tube: ASTM B88, Type L, Seamless, Water tube, hard-drawn temper	Copper tube: ASME B16.22, wrought copper, or cast bronze ASME B16.18, 300 psig	Victaulic Style 607H Installation-Ready coupling.

Sanitary, Sanitary Vent, and Storm Water	**Pipe Material**	**Fitting Material**	**Joint Material**

	Poly Vinyl Chloride (PVC); DWV pipe, ASTM D2665, Schedule 40, solid wall plain ends. PVC material shall comply with the material requirements of ASTM D1784 and have a cell classification of 1245 In return air plenums, wrap pipe with plenum wrap complying with material requirements of ASTM E84, NFPA 262, and UL 910.	Socket ASTM D2665. PVC material shall comply with the material requirements of ASTM D1784 and have a cell classification of 12454.	ASTM D2855, solvent weld with ASTM D2564 solvent cement.

Sanitary and Storm Water Sumps and Ejectors Pressure Discharge Piping	**Pipe Material**	**Fitting Material**	**Joint Material**
	Copper Drainage Tube, Type K, ASTM B88	Wrought Copper ASME B16.22	Soldered; ASTM B32, Alloy Sb5 (95% tin and 5% antimony), lead free
	Copper Drainage Tube, Type K, ASTM B88	Copper tube: ASME B16.22, wrought copper, or cast bronze ASME B16.18	Victaulic Style 607 Installation-Ready coupling.

Air Conditioning Condensate, Equipment Drains, and Overflows	**Pipe Material**	**Fitting Material**	**Joint Material**
	PVC Pipe: ASTM D1785, Schedule 40, polyvinyl chloride (PVC) material.	ASTM D2466, Schedule 40, PVC	ASTM D2855, solvent weld with ASTM D2564 solvent cement.

	½" – 24" CPVC: Sch 80; ASTM F441 and ASTM D1784 - minimum cell classification 23447 Pipe. Chlorinated Polyvinyl Chloride (CPVC) material In return air plenums, wrap pipe with plenum wrap complying with material requirements of ASTM E84, NFPA 262, and UL 910.	ASTM F437, ASTM F439, and ASTM F1970 CPVC	Solvent weld with ASTM F493 solvent cement and ASTM F656 primer or Victaulic Company PGS-300 CPVC Piping system. Pipe and fittings cut grooved to Victaulic's PGS-300 groove specification.

Foundation Drains	**Pipe Material**	**Fitting Material**	**Joint Material**
	Perforated Plastic: ASTMD-2729, hole spacing per AASHTOM-252.	Not applicable.	Not applicable.
	CPVC Pipe: ASTM F441, Schedule 80, chlorinated polyvinyl chloride (CPVC) material.	ASTM F439, CPVC, Schedule 80, socket type	solvent weld with ASTM F493 solvent cement and ASTM F656 primer.

Fuel Oil	**Pipe Material**	**Fitting Material**	**Joint Material**
(Protector Pipe)	PVC Pipe: ASTM D1785, Schedule 80, polyvinyl chloride (PVC) material.	ASTM D2467, Schedule 80, PVC Use only long radius elbows.	ASTM D2855, solvent weld with ASTM D2564 solvent cement.
(Above Grade)	Steel Pipe: ASTM A53, Schedule 40, black	ASME B16.3 malleable iron or ASTM A234, wrought carbon steel and alloy steel welding type.	Threaded for pipe 2" and smaller, welded for pipe 2 ½" and larger

A. Alternate Piping System – Domestic Hot Water, Cold Water and Hot Water Circulating Piping.

A. IPS Grooved Copper Tubing System – Victaulic, Grinnell (or comparable acceptable product) roll grooved copper tube couplings, fittings, valves and other grooved components may be used as an option to soldered or brazed methods. All grooved components shall be of one manufacturer, and conform to local code approval and/or as listed by ANSI B31.1, ASME, UL/FM, IAPMO. Grooved end product manufacturer to be ISO-9001 certified. System shall be applicable in systems operating between -30°F and +250°F. See manufacturer's recommendations for gasket selection for services other than water.

B. Installation-ready couplings include a center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth.

C. Copper Tube (Type L): ASTM B88 – Roll grooved-ends as appropriate to pipe material, wall thickness, pressures, size and method of joining. Pipe ends to be grooved in accordance with Victaulic, or Grinnell current listed standards conforming to ANSI/AWWA C606.

D. Quality Assurance: To assure uniformity and compatibility of piping components in grooved end piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components.

E. Mechanical Couplings: "Installation Ready" stab-on design, for direct 'stab' installation onto roll grooved copper tube without prior field disassembly and no loose parts. Housings shall be ASTM A536 ductile iron cast rigid design coated with copper-colored enamel. Gasket shall be Grade "EHP" EPDM Suitable for domestic water and oil-free compressed air, or Grade "T" Nitrile suitable for air with oil vapors, and plated steel bolts and nuts. Victaulic Style 607H QuickVic™, Grinnell Style 640 with EHT gaskets (or comparable acceptable product.)

F. Grooved End Fittings: ASME B16.22 wrought copper or ASME B16.18 bronze casing with copper-tube dimensioned grooved ends (flaring of tube and fitting ends to IPS dimensions is not permitted).

G. Installation-Ready™ fittings for grooved end copper tubing shall be manufactured to copper-tube dimensions. Fittings shall be ductile iron conforming to ASTM A-536, Grade 65-45-12, with Installation-Ready™ ends, complete with PVDF (Poly Vinylidene Fluoride) and Grade "EHP" EPDM-HP [Grade 'T' Nitrile] gasket; and ASTM A449 electroplated steel bolts and nuts. System shall be rated to 300 psi (2065 kPa) with Type K or L Copper Tubing.

H. Flange Adapter: ASTM A536 ductile iron coated with copper-colored enamel, flat faced, designed for incorporating flanged components with ANSI Class 125 and 150 bolt-hole patterns to a grooved piping system. Victaulic Style 641 or Grinnell 61.

I. Mechanical-T Bolted Branch Outlet: Manufactured from ASTM A536 ductile iron and ASME B15.18 bronze castings with pressure-responsive, synthetic rubber sealing gasket. Victaulic Style 622 (or approved equal).

J. System shall be UL classified in accordance with ANSI/NSF-61 for potable water service, and shall be certified to the low lead requirements of NSF-372.

B. Alternate Piping System – Chlorinated Polyvinyl Chloride (CPVC) –Air Conditioning Condensate, Equipment Drains, and Overflows.

A. CPVC Copper Tube Size (CTS) SDR 11 tube and fittings ½"-2"

a. Material: FlowGuard Gold pipe compound shall meet cell class 24448 and the fitting compound shall meet cell class 23447 as defined by ASTM D1784. Pipe and fittings

shall meet or exceed requirements of ASTM D 2846, NSF 14, and NSF 61. Solvent cement shall meet or exceed ASTM F493.

b. Plenum rating: pipe and fittings meet the 25/50 flame and smoke requirement and are permitted to be installed in return air plenums per ICC Evaluation Service PMG-1264 and IAPMO Uniform Evaluation Service Evaluation Report UEL-5002.

c. Manufacturers: Charlotte Pipe, NIBCO, BOW Plastics, Sioux Chief, or Cresline

B. CPVC Schedule 80 IPS Piping System ½"-24"

a. Material: Corzan compound shall meet a minimum cell class 23447 as defined by ASTM D1784. Pipe shall meet or exceed the requirements of ASTM F441, NSF 14, and NSF 61. Fittings shall meet or exceed requirements of ASTM F437 and F439, NSF 14, and NSF 61. Solvent cement shall meet or exceed ASTM F493 and primer shall meet or exceed ASTM F656.

b. Plenum rating: Pipe and fittings listed by ICC-ES under PMG 1264. The following models have been tested in accordance to UL 723/ASTM E84 and meet the 25/50 flame spread/smoke developed requirements of the IMC and UMC for installation in ducts and plenums

1) ½" – 6" water filled Corzan® CPVC pipe and fittings have a flame spread index of 0 and a smoke developed index of no more than 20.

2) ½" – 2 dry Corzan® CPVC pipe and fittings for condensate lines have a flame spread index of 0 and a smoke developed index of no more than 20.

c. Manufacturers: Georg Fischer, NIBCO, Sioux Chief, or IPEX

d. Grooved Fittings: Victaulic Company PGS-300 CPVC Piping system. Pipe and fittings cut grooved to Victaulic's PGS-300 groove specification. Compatibility of gasket lubricant materials with CPVC must be confirmed with the coupling manufacturer.

2.2 UNDERGROUND PIPE MARKERS

A. Furnish materials in accordance with the requirements of the authority having jurisdiction.

B. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

C. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Domestic Water Service", "Fuel Oil Piping", or "Sewer Service" in large letters.

2.3 PIPING SPECIALTIES

A. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents:

A. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8" maximum thickness, except where thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125 cast-iron and cast bronze flanges.

b. Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.

B. ASME B16.20, for grooved, ring joint, steel flanges.

C. AWWA C110, rubber, flat face, 1/8 inch thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.

B. Flange Bolts and Nuts:

A. ASME B18.2.1, carbon steel, except where other material is indicated.

C. Plastic Pipe Flange Bolts, Washers and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated. Flat washers must be used under nuts and bolts. Gaskets to be full face, 1/8th inch thick, 70 durometer and of a material recommended for the application by the manufacturer.

D. Unions: Lead Free, ANSI B16.39, Class 150, malleable iron; female pattern; brass to iron seat; ground joint. Threads shall conform to ANSI/ASME B1.20.1. Unions in copper piping shall be sweat fittings with bronze seats designed for 200 psig working pressure.

E. Dielectric Unions: Lead Free, provide dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

F. Dielectric Fittings: Lead Free, provide dielectric fittings with appropriate end connections and piping materials. Dielectric fittings shall be as manufactured by Victaulic Style 47, Legend Valve Company Model T-575 or acceptable comparable product.

G. Dielectric Waterway: Copper silicon casting conforming to UNS C87850 with grooved and/or threaded ends. UL classified in accordance with NSF-61 for potable water service and shall meet the low-lad requirements of NSF-372. Basis of Design: Victaulic Series 647.

H. Strainers – “Y” Type:

A. Strainers shall be lead free and of the basket or "Y" design, as manufactured by Watts, Nibco, Victaulic, Wilkens (A Zurn company), Grinnell, Conbraco Industries; Apollo or an comparable acceptable product. Bodies shall have arrows clearly cast on the sides to show flow direction. Strainers shall be equipped with easily removable covers and standard stainless steel screens. Total area of perforations shall be not less than four times the cross section of the entering pipe.
B. Provide valved blow off connections for all strainers full size of blow off tapping, with capped ends.

I. Expansion Tanks:

A. Provide diaphragm type expansion tank as manufactured by Zurn Model WTTA, Amtrol – Therm-X-trol, Taco Model No. PAX, or Bell and Gosset Model PTA.

B. Size and number as indicated; construct of welded carbon steel for 125 psig working pressure, 375°F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity, by means of a flexible diaphragm securely sealed into tank. Provide taps for air charging fitting, and drain plug. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Tank, with taps and supports, shall be constructed, tested, and labeled in accordance with ASME Pressure Vessel Code, Section VIII, Division 1. Tanks shall be provided with integral base ring for vertical mounting.

J. "Y" type Strainer

A. Strainers shall be lead free as manufactured by Zurn/Wilkins, Mueller, Nibco Metraflex, Watts, Spirax Sarco, or Apollo.
B. 125 psig working pressure: Ductile Iron ASTM A536 main valve body, NSF approved epoxy finish, flanged end connections, bolted access cover, perforated Type 300 Series stainless steel screen, and bottom drain connection

K. Recessed Non-freeze Wall Hydrants:

A. Provide as manufactured by Jay R. Smith, Josam, Watts or Zurn Model No. Z1300.
B. ASME A112.21.3M, or ASSE 1019, cast-bronze, with chrome-plated face hinged locking cover tee handle removable key, automatic draining, vacuum breaker, ¾" inlet, and hose outlet. Bronze casing shall be length to suit wall thickness.

L. Vacuum Breakers:

A. Pipe Applied, Atmospheric Vacuum Breaker shall conform to ASSE 1001, with floating disc and atmospheric vent.
B. Hose connection vacuum breakers shall conform to ASSE Standard 1011, with finish to match hose connection.
C. Laboratory Faucet Vacuum Breakers: ASSE 1035, chrome plated; consisting of primary and secondary checks, intermediate vacuum breaker, threaded ends, 1/4" or 3/8" size as required, for continuous pressure application.
D. Vacuum breakers shall be lead free.

M. Reduced Pressure Backflow Preventers:

A. Reduced pressure type backflow preventers shall be lead free and shall be manufactured by Ames, Conbraco Industries; Apollo, Watts, Zurn/Wilkins, or an acceptable comparable product.
B. Reduced-pressure-principle assembly consisting of shutoff valves on inlet and outlet and strainer on inlet. Assemblies shall include test cocks and pressure-differential relief valve located between 2 positive seating check valves and comply with requirements of ASSE Standard 1013. Shut-off valves shall be provided in accordance with valves as specified in this section.
C. Shut-off and check valves shall be the same model as provided for system in which backflow preventer is being installed.
D. Valve stand shall be manufactured by: Ames, or Watts, or an acceptable comparable product.

a. Valve stands shall be provided in pairs. Stands shall be adjustable to accommodate varying heights.
b. Stands shall be corrosion resistant.
c. Mounting plates and Yokes shall be epoxy coated.
d. Yokes and mounting plates shall be of coated cast iron material. Support cylinders shall be of zinc plated material.

N. Dual Check Valve Backflow Preventer for Carbonated Beverage Machines:

A. Dual Check Valve shall lead free as manufactured by Conbraco Industries; Apollo Model CBBP, WATTS: Model SD-3 or comparable product by Spence, or Zurn/Wilkins.Model 740.
B. Certified to ANSI/NSF Standard18, Manual Food and Beverage Dispensing Equipment.
C. ASSE 1022 approved Dual Check with Atmospheric Vent.
D. 316 Stainless Steel body.
E. All rubber compounds complying with FDA Food Additive regulations.
F. Endurance tested for minimum 500,000 pumping cycle.
G. Atmospheric port shall provide visual indication of second check.
H. Wye pattern strainer for water supply installation.

O. Water Hammer Arresters:

A. Water hammer arresters shall be Zurn Model WH-2950-XL. Comparable products as manufactured by Jay R. Smith, Josam, Precision Plumbing Products, or Watts, may be submitted for review.
B. ASSE 1010, or PDI WH-201, “Water Hammer Arresters,” “latest edition”, bellows or piston type with pressurized cushioning chamber. Sizes are based on water-supply fixture units, sizes “A” through “F” and PDI WH-201, sizes “A” through “F.”
C. Water Hammer Arresters shall be lead free when used with lead-free end user devices and piping that are required by Maryland law to be lead free.

P. Welding Materials: Comply, with Section II, Part C. ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

Q. Drainage System Specialties

A. Horizontal Backwater Valves: ASME A112.14.1, cast iron body, with removable bronze swing check valve, threaded or bolted cover, as manufactured by Jay R. Smith, Josam, Watts, or Zurn.

a. Extension: Full size, service class, cast iron soil pipe extension to field installed cleanout at floor. Extensions shall be Zurn Model Z1095-FC. Comparable products as manufactured by Josam or J.R. Smith may be submitted for review.
B. Vent Caps shall be Zurn Model Z193 cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe. Comparable products as manufactured by Josam or J.R. Smith may be submitted for review.
C. Cleanouts: ASME A112.36.2M, cast-iron body with straight threads and gasket seal or taper threads for plug flashing flange and clamping ring, and a brass closure plug.

Cleanouts for installation in floors not having membrane waterproofing may be furnished without clamping ring.

Cleanouts in Concrete Floors	Zurn Model No. Z-1400-BZ1-BP, or Watts Model C0-200-RX cast iron body, bronze plug to suit floor finish with adjustable round scoriated top. Comparable products as manufactured by J.R. Smith or Josam may be submitted for review.
Cleanouts in Finished Floors	Zurn Model No. ZN-1400-BZ1-BP cast iron body, bronze plug and scoriated adjustable nickel bronze leveling cover. ZN-1400-X-BP cast iron body, bronze plug and recessed nickel bronze top to suit floor finish for vinyl tile or ZN-1400-CM-BP cast iron body, bronze plug with nickel bronze top and carpet marker to suit floor finish for carpet. Comparable products as manufactured by Jay R. Smith, Josam, or Watts may be submitted for review.
Cleanouts in Piping	Zurn Model No. Z-1440-BP, or Watts Model C0-380 epoxy coated cast iron body with bronze plug, comparable products as manufactured by Josam or J.R. Smith may be submitted for review.
Cleanouts in Walls	Zurn Model No. Z-1441-BP-VP, or Watts Model C0-380-RD style to suit wall finish, with epoxy coated cast iron body, bronze plug and vandalproof screws. Comparable products as manufactured by J.R. Smith or Josam may be submitted for review.

D. Floor Drains: Floor drains/sinks shall be as manufactured by Zurn, or Watts. Comparable products as manufactured by Jay R. Smith, Josam, Orion, or Wade may be submitted for review.

   a. Floor Drains (Sanitary Waste):
      1) Zurn Model ZN-415-BZ6-TC-P, or Watts Model FD-103-A6, Dura coated cast iron body and clamp collar with 6” diameter nickel bronze leveling strainer with removable debris cover and trap primer connection.
      2) Zurn Model ZN355-75, N.P.T. trap primer connection, integral trap, anchor flange and adjustable nickel bronze slotted strainer secured with spanner type vandal-proof screws.

E. Deep Seal Traps: Zurn Model Z-1000-P Cast iron or bronze, with inlet and outlet matching connected piping, cleanout where indicated, and trap seal primer valve connection. Comparable products as manufactured by Charlotte Pipe, Jay R. Smith, or Josam may be submitted for review.

   a. 2-Inch Size: 4-inch-minimum water seal.
   b. 2 1/2 Inches and Larger: 5-inch-minimum water seal.

F. Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.

G. Air Gap Fittings: ASME A112.1.2, cast iron or cast bronze, with fixed air gap, inlet for drain pipe or tube, and threaded or spigot outlet.

H. Roof Drains:

a. Bi-functional roof drain with 45° primary outlet connection. Powder coated cast iron deep sump body with combination membrane flashing clamp/gravel guard, deck plate mount, overflow pipe with standard 5-1/4'' high cast iron dome and 6-1/4'' high cast iron overflow.
   1) Provide as manufactured by Zurn, Model 100C-DP Froet Drain. Comparable products as manufactured by Watts, Jay R. Smith, or Josam may be submitted for review.

I. Downspout nozzle: Zurn Model Z-199, or Watts Model RD-940. Comparable product as manufactured by Jay R. Smith, or Josam may be submitted for review.

J. OIL SEPARATOR

a. Striem Oil Reserve/Tanker oil/sand separator shall be lifetime guaranteed and made in USA of Polyethylene with minimum 3/8" uniform wall thickness.
b. Separator shall be furnished for below grade installation, with field adjustable riser system, built-in flow control and vent connections.
c. Cover shall provide water/gas-tight seal and have traffic rated cover.
d. Separator shall be certified to IAPMO IGC 183-2016 and carry a UPC listing.
e. Add Clean Sweep oil coalescing media for effluent quality of 5ppm (mg/L) oil content.

R. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type where required to conceal protruding fittings and sleeves.

A. Inside Diameter: Closely fit around pipe, tube, and insulation.
B. Outside Diameter: Completely cover opening.
C. Cast Brass: One-piece, with set-screw.
D. Cast Brass: Split casting, with concealed hinge and set-screw.

a. Finish: Rough brass.
b. Finish: Polished chrome plate.

E. Stamped Steel: One-piece, with set-screw and chrome-plated finish.
F. Stamped Steel: Split plate, with concealed hinge, set-screw, and chrome-plated finish.
G. Cast-Iron Floor Plate: One-piece casting.

S. Dielectric Fittings: Lead free assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.

A. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
B. Insulating Material: Suitable for system fluid, pressure, and temperature.
C. Dielectric Unions: Factory-fabricated, union assembly for 250-psig minimum working pressure at a 180°F temperature.
D. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150-or 300-psi minimum pressure to suit system pressures.
E. Dielectric-Flange Insulation Kits: Materials for flange isolation kits on pipes containing drinking/potable water (up to 280°F) shall consist of the following components:

a. Isolating and Sealing Gasket:
   1) The full faced, NSF 61 certified, isolating and sealing gasket shall be LineBacker® 61™ Sealing Gasket (LB61) – Type "E", 1/8" thick, G-10 retainer containing a precision tapered groove to accommodate the controlled

compression of a EPDM quad-ring sealing element. Sealing element placement shall accommodate either flat, raised face or RTJ flanges.

2) The quad-ring seal shall be pressure energized. The G-10 retainer shall have a 550 volts/mil dielectric strength and a minimum 50,000 psi compressive strength.

3) The full faced flange isolating gasket (weld-neck) shall be equal to or slightly smaller than the bore of the flange; (slip-on) shall be equal to or smaller than the I.D. of mating pipe.

b. Full Length Bolt Isolating Sleeves:

1) One full length G-10 Sleeve (extending half way into both steel washers) for each flange bolt. The G-10 shall be a 1/32 inch thick tube with a 400 volts/mil dielectric strength and water absorption of 0.10% or less.

c. Washers:

1) Two, 1/8 inch thick, G-10 isolating washers for each bolt. Their compressive strength shall be 50,000 psi, dielectric strength 550 volts/mil and water absorption 0.10% or less.

2) Two, 1/8 inch thick zinc plated, hot rolled steel washers for each bolt. The I.D. of all washers shall fit over the isolating sleeve and both the steel and isolating washers shall have a same I.D. and O.D.

d. Quality:

1) Flange isolating kits shall be manufactured at a facility that has a registered ISO 9001:2008 Quality Management System. Submittals shall include copy of valid ISO registration and NSF 61 certification.

e. Basis of Design:

1) Flange gasket kits shall be manufactured by PSI-Pipeline Seal and Insulator, Inc., Houston, Texas. Comparable products shall be submitted as required under Section Product Requirements for comparable product review. Products should be submitted to engineer 10 days prior to bid due date.

F. Dielectric Couplings: Lead free galvanized-steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225° temperature.

G. Dielectric Nipples: Lead free electroplated steel or ductile nipple, having inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig working pressure at 230 °F temperature. Victaulic Style 47 or Grinnell Style 407.

H. Dielectric Waterway: Copper silicon casting conforming to UNS C87850 with grooved and/or threaded ends. UL classified in accordance with NSF-61 for potable water service, and shall meet the low-lead requirements of NSF-372. Basis of Design: Victaulic Series 647.

T. Pipe Guides:

A. Systems greater than 70°F operating temperature: Provide Erico (formerly known as Michigan) Model No. 650, or an acceptable comparable product.

B. Systems less than 70°F operating temperature: Provide Erico (formerly known as Michigan) Model No. 651, or an acceptable comparable product.

C. For CPVC: Shall be chemically compatible with CPVC

U. Pipe Anchors:

A. Steel Shapes and Plates: ASTM A 36/A 36M.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.

C. Washers: ASTM F 844, steel, plain, flat washers.
D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened Portland cement concrete, and tension and shear capacities appropriate for application.

a. Stud: Threaded, zinc-coated carbon steel.
b. Expansion Plug: Zinc-coated steel.
c. Washer and Nut: Zinc-coated steel.

E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened Portland cement concrete, and tension and shear capacities appropriate for application.

a. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
c. Washer and Nut: Zinc-coated steel.

F. Concrete: Portland cement mix, 3000 psi minimum. Refer to Division 03 Section: “Cast-in-Place Concrete” for formwork, reinforcement, and concrete. Grout: Refer to Division 22 Section: “Common Work Results for Plumbing.”
G. For CPVC: Shall be chemically compatible with CPVC

V. Thermometers, General

A. Scale Range: Temperature ranges indicated in degrees Fahrenheit shall be provided for services listed as follows:

a. Domestic Hot Water: 30 to 180°F, with 2-degree scale divisions.
b. Domestic Cold Water: 0 to 100°F, with 2-degree scale divisions.

B. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

C. Liquid-in-glass Thermometers

1) Provide as manufactured by H.O. Trerice, Weiss Instruments, Weksler Instrument Corp., or Miljoco.
2) Description: ASTM E1, liquid-in-glass thermometer. Delete ASTM E1 as this specification is strictly set aside for engraved glass tube laboratory thermometers. Insert ANSI/B40.2 in its place.
3) Case: High Pressure Die-cast aluminum-finished in baked-epoxy enamel, glass front, spring secured, 9 inches long.
4) Adjustable Joint: Finished to match case, 180° (3.1rad) adjustment in vertical plane, 360° adjustment in horizontal plane, with locking device.
5) Tube: Blue-reading, organic liquid-filled instead of mercury-filled, with magnifying lens.
6) Scale: White coated aluminum with permanently baked bold black markings.
7) Stem: Copper-plated steel, Zamac Alloy, aluminum, or brass for a separable socket of length to suit installation.
8) Thermowell: Brass NSF/ANSI 372 separable socket of suitable length for installation.

W. Pressure Gages, General

A. Provide as manufactured by H.O. Trerice Co., Weiss Instruments, Inc., Weksler Instrument Corp., or Miljoco.

a. Description: ASME B40.1, Grade A phosphor-bronze Bourdon-tube pressure gage, with bottom connection.
b. Case: Drawn steel, brass, or aluminum with 4 1/2 -inch -diameter glass lens.
c. Connector: Brass, 1/4" inch NPS.
d. Scale: White-coated aluminum, with permanently etched markings.
e. Accuracy: Plus or minus 1 percent of range span.
f. Needle Valve: Exceed pressure and temperature rating of installation.

X. Test Plugs:

A. Provide as manufactured by Flow Design, Inc., Peterson Equipment Co., H.O. Trerice, or Miljoco, Weiss.
B. Description: Nickel-plated brass-body test plug in 1/2" inch fitting.
C. Body: Length as required to extend beyond insulation.
D. Pressure Rating: 500 psig minimum.
E. Core Inserts: 2 self-sealing valve types, suitable for inserting a 1/8” inch (3mm) outside-diameter probe from a dial thermometer or pressure gage.
F. Core Material: According to the following for fluid and temperature range:

a. Air, Water, Oil, and Gas: 20°F to 200°F, neoprene rubber.
b. Air and Water: Minus 30°F to 275°F, ethylene-propylene-diene-terpolymer (EPDM) rubber.

G. Test-Plug Cap: Gasketed and threaded cap, with retention chain.
H. Test Kit: Provide test kit consisting of 1 pressure gage and gage adapter with probe, 2 bimetal dial thermometers and a carrying case.
I. Pressure Gage and Thermometer Ranges: Approximately 2 times systems operating conditions.

Y. Domestic Water Mixing Valves

A. Digital Mixing Center Electronic Mixing Valve: stainless steel valve body and fittings; fast reacting acuator; control box; temperature probe; power supply; includes necessary fittings and nipples; ASSE 1017, NSF 372 and cUPC approved.

a. Maximum Inlet Pressure: 150 psi (1034 kPa).
b. Maximum Inlet Temperature: 200 degrees F (93 degrees C).
c. Inlet/Outlet Temperature Differential: 5 degrees F .
d. Performance: Temperature maintained to within ASSE and cUPC guidelines if change in hot or cold water is not more than 30 degrees F (17 degrees C); pressure fluctuations compensated for up to 50 percent drop in inlet supply pressure; water flow reduced if supply or thermostat fails.
e. Capacity: See schedule
f. Minimum Flow: .25 gpm (1 lpm) when properly installed in recirculated system.
g. Finish: Stainless Steel

B. Thermostatic Mixing Valves:

a. Provide Thermostatic Mixing Valves as manufactured by Acorn Controls, Lawler, Leonard or Powers.
b. The thermostatic mixing valve shall be IAPMO lab certified to ASSE 1017 and CSA standards and capable of meeting the control accuracy requirements of these standards at the manufacturers listed minimum flow rates.
c. The valve shall contain an advanced paraffin sensor with a temperature range of 100F to 160F and factory set at 120F with a lock nut to prevent unauthorized temperature changes.
d. Checks and screens are required at both inlets.
e. Maximum inlet pressure is 125 PSI
f. Maximum inlet temperature is 180F
g. Inlet/Outlet temperature differential minimum (approach) is 5F
h. Provide external ball valves at all inlets and outlets
i. Body material to be Lead-Free brass with corrosion resistant internal components.

C. ASSE 1016 Shower Mixing Valves:

a. Provide Acorn Controls model SV16, Hydroguard T/P Series E700 thermostatic tempering valves as manufactured by Powers, comparable products as manufactured by Bradley, or Leonard Valve Company may be submitted for review as a comparable product.
b. Valve shall operate with a non-rising stem and include ceramic shutoffs.
c. Cartridge shall be self-contained.
d. Valves shall be suitable for ½" inlet and ½" NPT top outlet piping connections.
e. Maximum hot water supply temperature of 180°F, minimum hot water supply temperature of 5°F above setpoint.
f. Capacity without checkstops shall be 4 gpm at 45 PSI.
g. Maximum operating pressure of 125 psi.
h. Temperature ranges ASSE 1016 T/P 85° - 115°F to include a field adjustable limit stop factory set at 110F and capable of supplying mixed water temperature within 5F of hot water supply temperature.
i. Valve shall always open through cold water to maximize bather safety.
j. Listing – ASSE 1016-2011.

D. ASSE 1070 Public Hand Washing Mixing Valve:
Provide Acorn Controls model ST70, Watts Series LFUSG – B, Thermostatic Mixing Valve, Leonard Models 170-LF-BP or 170A-LF-BP, Conbraco Industries; Apollo Model 34DLF, or Thermostatic Mixing Valve. Comparable products as manufactured by Bradley or Zurn may be submitted for review as a comparable product.

a. ASSE 1070 and IAPMO cUPC listed to control the temperature of hot water.
b. Lead Free Brass 4 – Port 'H' pattern body or factory supplied tee connection.
c. Include Integral Check Valves, Integral Screens and adjustment nut with locking feature.
d. Ranges
1) Minimum supply pressure: 30 Psi
2) Hot Inlet Temperature: 120° - 180°F
3) Cold Inlet Temperature: 39° - 80°F
4) Minimum Inlet Temperature Difference: 5°F
5) Supply Temperature range: 85° - 115°F
6) Maximum Pressure: 125 Psi
7) Minimum Flow: 0.25 GPM

8) Maximum Flow: 4.00 GPM

2.4 SLEEVE PENETRATION SYSTEMS

A. General: Provide protective sheathing or wrapping between metal pipes and sleeves to prevent pipes from corroding.

B. Sleeves shall be provided around all pipes through walls, floors, ceilings, partitions, structure members or other building parts. Sleeves through walls and floors shall be standard weight galvanized iron pipe two sizes larger than the pipe or insulation so that pipe or insulation shall pass through freely with space for movement for all piping which passes through masonry or concrete walls or floors. Provide 20 gauge galvanized steel sheet or galvanized pipe sleeves for all piping passing through frame walls.

C. Sleeves through floors shall be flush with the floor except for sleeves passing through Mechanical Rooms which shall extend ¾" above the floor. Space between the pipe and sleeve shall be caulked. Escutcheon plates shall be constructed to conceal the ends of sleeves.

D. Sleeves through walls and floors shall be sealed.

E. Penetrations through fire rated walls and floors.

A. All plumbing pipe and fixture penetrations through fire rated floors and walls shall be provided and firestopped using UL classified through penetration firestop devices as manufactured by ProSet Systems, Inc. The fire rating of the firestop device shall be equivalent or greater than the fire rating of the floor or wall penetrated. All firestop devices shall be provided in accordance with manufacturer's instructions.

a. Penetrations by hot and cold domestic water lines shall be provided using ProSet System A firestop devices.
b. Penetrations by bathtub drains, water closet openings, shower drains and floor drains shall be provided using ProSet System B firestop devices.

B. All penetrations by fire protection water lines through fire rated floors and walls shall be provided and firestopped using UL classified through penetration firestop devices, System A, as manufactured by ProSet Systems Inc.

a. The fire rating of the firestop device shall be equivalent to or greater than the fire rating of the floor or wall penetrated.
b. All firestop devices shall be provided in accordance with manufacturer's instructions.

C. When using CPVC: Provide caulk, sleeves, mechanical sleeve seals, sealers, etc. used for penetrations that are chemically compatible with CPVC compounds per FBC Compatibility or consult with product manufacturer.

2.5 FUEL OIL LEAK DETECTION AND LOCATION SYSTEM

A. Furnish materials in accordance with Authority Having Jurisdiction requirements

B. Product Description: Microprocessor based monitoring unit, sensor cable, probes, system layout map, and auxiliary equipment to provide continuous monitoring of sensing strings for leaks, shorts, breaks, and probe activation. When any of these conditions occur at any point along cable, alarm sounds, type of condition is identified and location displayed. System monitors interstitial space of double contained piping and trenches. Construct system to meet requirements of UL 913.

C. Performance:

A. Detect and identify location of first leak within 0.1 percent of sensor string length or 5 feet whichever is greater. Identify type of alarm.
B. Sensing String Length: Monitor up to 15,000 feet of cable for each sensor string from single monitoring unit.
C. Multiple Leaks: Detect and locate multiple leaks or additional liquid on sensor cable.
D. Breaks and Shorts: Identify location of breaks and shorts on cable. When faults occur, sound alarm, and display on front of monitoring unit type of fault and location of fault.
E. Liquids Detected: Detect liquids, including aqueous, hydrocarbon, conductive, and nonconductive liquids. Furnish two cables to detect and differentiate between hydrocarbons or solvents and aqueous liquids.
F. Remote Annunciation: Furnish relays for remote indication of alarm conditions. Relays indicate no alarm conditions exist, alarm condition exists but has not yet been acknowledged, and alarm condition exists and has been acknowledged. Communications available via RS-232 and ASCII communication protocols to allow central point monitoring and control via remote computer.
G. Archives: Record significant events in nonvolatile memory with capacity of 900 events. When memory becomes full, recorded events are deleted from memory on first-in-first-out basis. Each recorded event includes time and date event occurred. Archives retrievable through RS-232 and ASCII communication protocols.
H. System Status: Continuously give positive indication of monitoring sensing string and status of sensing string. System clock indicates time and date on LCD of monitoring panel. System clock is programmable. Include time and date indication for events recorded in memory.
I. Security: Assignable password security for varying levels of system access. Minimum of 20 passwords available within system. System to not allow unauthorized modifications to sensing string to be made without causing alarm condition.
J. Sensor Types: Capable of monitoring sensor cables, probe sensors, and switch sensors such as float switches, and pressure switches, from same monitoring panel. English language displays indicate status of sensors.
K. Sensitivity: System to not detect incidental liquid contact. Sensitivity field adjustable to increase or decrease amount of wetted cable needed to cause alarm.

D. Components:

A. Monitoring Unit:

a. Indicates when liquid comes in contact with sensor cable by sounding alarm, actuating output relays, displaying message leak has been detected and giving location of leak on sensing string.

b. Unit furnished with green LED on panel front indicates unit is powered. Furnish two line by forty character backlit LCD visible from front of unit to provide system data. Red LED on panel front indicates alarm condition has occurred. Unit power requirements: 120/240 VAC, 100 VA, 50/60 Hz, single phase. Equip with RS-232 communication port and minimum of one common and one SPDT output relay for each cable, rated for 250 VAC, 10 amp.

c. Enclose in modified NEMA 250 Type 4X enclosure. UL listed to provide connections for intrinsically safe sensor circuits for use in hazardous locations. Ability to locate leak does not depend on battery backed up functions. In event of power failure, store system conditions and parameters in nonvolatile memory allowing unit to automatically resume monitoring, without resetting, upon restoration of power. Furnish on-off switch in panel.

B. Sensor Cable: Coaxial construction consisting of insulated copper center conductor, spacer material, and outer braid. Center conductors not less than 20 AWG for mechanical strength. Cables field repairable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section: “Administrative Requirements”: Verification of existing conditions before starting work.

B. Verify excavations and trenches are ready to receive piping.

C. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of installed devices. Do not proceed with installation until unsatisfactory conditions have been corrected.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

E. Examine grooved ends for form and cleanliness. Ends shall be clean and free from indentations, projections, and roll marks in the area from valve, fitting, or pipe end to (and including) the groove.

F. Examine substrates and conditions under which pipe expansion joints, pipe alignment guides, and pipe anchors are to be installed. Do not proceed until unsatisfactory conditions have been corrected.

G. Do not enclose, cover, or put into operation any piping system until it has been inspected by the authority having jurisdiction and tested as specified herein.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel or groove plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Unions and flanges for servicing and disconnect are not required in installations using grooved mechanical joint couplings. (The couplings shall serve as disconnect points if required.)

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

F. Preparation For Testing: Prepare water piping and condensate piping in accordance with ASME B31.9, and as follows:

   A. Test for leaks and defects in new piping systems and parts of existing systems that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of system tested.
   B. Leave joints including welds un-insulated and exposed for examination during the test.
   C. Provide temporary restraints for expansion joints, which cannot sustain the reactions due to test pressure. If temporary restraints are not practical, isolate expansion joints from testing.
   D. Flush system with clean water. Clean strainers.

      a. Open a drain at the low point of the system while replacing the water through the make-up at the same rate.
      b. Continue flushing until clean water shows at the drain, but for not less than 24 hours.
      c. After flushing, remove strainers and clean and replace them.
      d. System shall be drained and flushed before final filling.
      e. Flushing pumps are to have fine mesh construction strainers installed and shall be pulled and cleaned after flush.
      f. Coordinate with Division 23 Section: “HVAC Piping Systems Cleaning and Treatment”.

   E. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.
   F. Install relief valve set at a pressure no more than one-third higher than the test pressure, to protect against damage by expansion of liquid or other source of overpressure during the test.

3.3 EXCAVATION

A. Excavation for Utility Trenches

A. Excavate trenches to indicated gradients, lines, cross sections, elevations and subgrades.
B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe.

a. Clearance: 8 inches minimum each side of pipe.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, etc. Remove projecting stones and sharp objects along trench subgrade.

a. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, hand-excavate trench bottoms and support pipe on an undisturbed subgrade.
b. For pipes 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tampered sand backfill.
c. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

B. Unauthorized Excavation

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation.

C. Backfill

A. Place and compact backfill in excavations promptly, but not before completing the following:

a. Construction below finish grade including, where applicable, subdrainage, damp proofing, water proofing and perimeter insulation.
b. Surveying locations of underground utilities for Record Documents.
c. Testing and inspecting underground utilities.
d. Removing concrete formwork.
e. Removing trash and debris.
f. Removing temporary shoring and bracing, and sheeting.
g. Installing permanent or temporary horizontal bracing on horizontally supported walls.
h. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe.
1) Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping to avoid damage or displacement of piping. Coordinate backfilling with utilities testing.
i. Backfill voids with satisfactory soil while installing and removing shoring and bracing.
j. Place and compact final backfill of satisfactory soil to final subgrade elevation.
k. Install detectable warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavement and slabs.

D. Compaction of Soil Backfills and Fills

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

a. Under structure, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 92 percent.
b. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
c. Under lawn or unpaved areas, scarify and recompact top 6 inches subgrade and compact each layer of backfill or fill soil material at 85 percent.
d. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.
e. Against foundation walls, scarify and recompact with and operated equipment within 3 feet of wall to avoid overstressing the wall at 95 percent.

3.4 INSTALLATION OF PIPING, GENERAL

Piping

A. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
B. Install concentric reducers where pipe is reduced in size in the direction of flow, with bottoms of both pipes and reducer flush.
C. Connect branch piping to mains from top of main, unless specific otherwise for specific systems.
D. Install supports in accordance with Division 22 Section: “Hangers and Supports for Plumbing Piping and Equipment”.
E. Make changes in directions and branch connections using fitting, pull tees shall not be permitted.
F. Install flanges, flange kits, and unions in pipes 2 inch and smaller, adjacent to each valve, at final connections each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
G. Install dielectric unions where piping of dissimilar metals are joined.
H. Install flanges on valves, apparatus, and equipment having 2 1/2" inch and larger connections.
I. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.
J. Install flexible connectors at inlet and discharge connections to pumps and other vibration producing equipment.
K. Install strainers on the supply side of each control valve, pressure regulating valve, and elsewhere as indicated. Install ¾” inch NPS nipple and ball valve in blow down connection of strainers. Use same size nipple and valve as blow-off connection of strainer.

L. Anchor piping to ensure proper direction of expansion and contraction. Anchors shall attach to the building structure to prevent pipe movement. Anchors shall be installed in such a manner to prevent damage to the building structure. Anchors shall be securely welded to the piping being anchored. Install expansion loops and joints as indicated on the Drawings.
M. Install pipe sleeves at all wall and floor penetrations. Provide protective sheathing or wrapping between metal pipes and sleeves to prevent pipes from corroding.
N. Seal pipe penetrations of fire separations specified in Division 07 Section: "Joint Firestopping."
O. Hanger supports, and anchors are specified in Division 22 Section: "Hangers and Supports for Plumbing Piping and Equipment."
P. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, ¾" ball valve, and short ¾" threaded nipple and cap.
Q. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inch and larger shall be sheet metal.
R. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.
S. In concealed locations where piping is installed through holes or notches in studs, joists, rafters or similar members less than 1 ½" from the nearest edge of the member, the pipe shall be protected by steel shield plates. The plates shall be made of gage 16 and shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 2" above sole plates and below tip plates.
T. CPVC Piping: Ancillary products coming into contact with pipe and fittings must be chemically compatible as per FBC System Compatibility Program. For products not listed on one of these program lists, consult the product manufacturer for compatibility with CPVC.

B. INSTALLATION - ABOVE GROUND PIPING

A. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
C. Group piping whenever practical at common elevations.
D. Sleeve pipe passing through partitions, walls and floors.
E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Provide access where valves and fittings are not accessible.
G. Install non-conducting dielectric connections wherever jointing dissimilar metals.
H. Establish invert elevations, slopes for drainage to ¼ inch per foot 2 percent minimum. Maintain gradients.
I. Slope piping and arrange systems to drain at low points.
J. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
K. Install piping penetrating roofed areas to maintain integrity of roof assembly.
L. CPVC Piping: Ancillary products coming into contact with pipe and fittings must be chemically compatible as per FBC System Compatibility Program. For products not listed on one of these program lists, consult the product manufacturer for compatibility with CPVC.

C. Joint Construction

A. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ANSI/ASME B1.20.1.

a. Cut threads full and clean using sharp dies.
b. Ream threaded ends to remove burrs and restore full inside diameter.
c. Apply pipe joint lubricant or sealant, suitable for the service for which the pipe is intended, on the male threads at each joint.
d. Tighten joint to leave not more than 3 threads exposed.
e. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
f. Align threads at point of assembly.
g. Apply appropriate tape or thread compound to the external pipe threads.
h. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
i. Damaged Threads: Do not use pipe with threads which are corroded or damaged.
j. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

B. Welded Joints: Weld pipe joints in accordance with ASME B31.9 and ASME B31.1, where required by COMAR.

C. Brazed Joints: For copper tube and fittings, braze joints in accordance with ASME B31, “Standard Code for Pressure Piping” and AWS “Brazing Manual.”

a. Remove stems, seats, and packing of valves and accessible internal parts of valves before brazing.
b. Braze joints in accordance with ASME B31.1.
c. Fill the tubing and fittings during brazing with nitrogen under a continuous purge to prevent formation of scale.
d. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
e. Heat joints to proper and uniform temperature.
f. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Provide adequate ventilation and avoid breathing fumes.

D. Solder Joints: Solder joints shall be made in accordance with ASTM B828. Cut tube ends shall be reamed to the full inside diameter of the tube end. Joint surfaces shall be cleaned. A flux conforming to ASTM B813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B32. The joining of water supply piping shall be made with lead free solder and fluxes.

E. Mechanical Joints: Follow grooved-end mechanical coupling manufacturer's written instructions. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved system manufacturer. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. A factory-trained field representative shall provide on-site training for contractor’s field personnel in the proper use of grooving tools and installation of grooved

piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

a. Tongue and recess couplings (required a gap and specific torque value to obtain specified performance) will only be permitted if a torque wrench is used for installation. Required torque shall be in accordance with manufacturer's latest installation instructions and best practices recommendations.

F. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

G. Grooved Joints: Assemble joints in accordance with fitting manufacturers written instructions. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved system manufacturer. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. A factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

H. CPVC Pipe Joint Construction: Assemble joints in accordance to manufacturer's instructions. Cut pipe square, ream interior or pipe, chamfer the exterior of the pipe, wipe/clean filings and other construction debris off of pipe and fitting, solvent cement application per training and either One-Step or Two-Step as required, fully insert pipe into fitting, ¼ turn as inserting, hold for set-time, wipe off excess solvent cement. A factory-trained field representative shall provide on-site training for contractor's field personnel.

3.5 INSTALLATION OF THREADED CONNECTIONS

A. Align threads at point of assembly.

B. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.

C. Assemble joint, wrench tight.

3.6 INSTALLATION OF FLANGED CONNECTIONS

A. Align flange surfaces parallel.

B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.7 INSTALLATION AND TESTING OF PRESS FITTINGS AND COPPER TUBING

A. Press connections: Press-seal fittings, ½-inch – 4-inch bronze, stainless steel or copper: Pipe ends shall be cut on a right angle (square) to the pipe. Pipe ends shall be reamed and chamfered, all grease, oil or dirt shall be removed from the pipe end with a clean rag. Visually examine the fitting sealing element to insure there is no damage, and it is properly seated into the fitting. Insert pipe fully into the fitting. Make a mark with a felt tip pen on the pipe at the face of the fitting. Always examine the tube to insure it is fully inserted into the fitting prior to pressing the joint. Press-seal fittings shall be installed according to the most current edition of the manufactures installation guidelines with manufacture recommended tools. Sealing elements shall be verified for the intended use. Installers shall attend the press-seal fitting manufactures installation training class. After Press fittings have been installed a “two step test” shall be followed. Utilizing air, or dry nitrogen, pressurize the system between .5 psi and 45 psi. Check the pressure gauge for pressure loss. If the system does not hold pressure, walk the system and check for un-pressed fittings. Should any un-pressed fitting/s be identified ensure the pipe is fully inserted into the fitting and properly marked prior to pressing the joint. After appropriate repairs have been made, test the system per local code, or specification requirements, not to exceed 200 psig.

3.8 INSTALLATION OF METERS, GAGES, THERMOMETERS, ETC.

A. Meters/Gages

A. General: Where indicated, install meters and gages of types, sizes, capacities, and with features indicated.
B. Install meters, gages, and accessories according to manufacturers’ written instructions for applications where used.
C. Install thermometers and adjust vertical and tilted positions.
D. Remote-Reading Dial Thermometers: Install in control panels with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
E. Thermometer Wells: Install in vertical position in piping tees where thermometers are indicated.

a. Install wells with stem extending minimum of 2 inches into fluid.
b. Install wells with stem extending to center of pipe.
c. Fill wells with oil or graphite and secure caps.

B. Pressure Gages

A. Install pressure gages in piping tee with pressure gage face located on pipe at most readable position.
B. Install in the following locations and elsewhere as indicated:

a. At suction and discharge of each pump.
b. At building water service entrance.
c. On expansion tanks.

C. Needle Valves: Provide ¼” needle valve in piping tee, with snubber.

C. Installation - Test Plug

A. Install test plugs in piping tees where indicated, located on pipe at most readable position. Secure cap.

D. Installation - Flow-measuring System, Flow Element And Meter

A. General: Install flow meters for piping systems located in accessible locations at most readable position.
B. Locations: Install flow measuring elements and meters at discharge of each pump and elsewhere as indicated.
C. Differential-Pressure-Type Flow Elements: Install minimum straight lengths of pipe upstream and downstream from element as prescribed by the manufacturer's installation instructions.
D. Install connection fittings for attachment to portable flow meters in readily accessible locations.
E. Permanently Mounted Meters for Flow Elements: Install meters on walls or brackets in accessible locations.
F. Install connections, tubing, and accessories between flow elements and meters as prescribed by manufacturer's written instructions.

E. Connections - Meters

A. Install meters and gages adjacent to machines and equipment to allow servicing and maintenance.
B. Connect flow-measuring-system elements to meters.
C. Connect flow-meter transmitters to meters.
D. Make electrical connections to power supply and electrically operated meters and devices.

F. Adjusting and Cleaning - Meters

A. Calibrate meters according to manufacturer's written instructions, after installation.
B. Adjusting: Adjust faces of meters and gages to proper angle for best visibility.
C. Cleaning: Clean windows of meters and gages and factory-finished surfaces. Replace cracked and broken windows and repair scratched and marred surfaces with manufacturer's touchup paint.

G. Portable Meters

A. Turn-over portable meters to the Owner upon completion of the project.

3.9 INSTALLATION – FUEL OIL LEAK DETECTION AND LOCATION SYSTEM

A. Install cable in interstitial space in piping system.

B. Install cable on flat surfaces with hold down clips every 8 feet and cable tags every 50 feet.

C. Graphic Locator Map: Provide location map with system reflecting actual installation showing system configuration and sensing string layout. Furnish length along cable as references to locate leaks. Base footage on calibration points.

D. Calibration Points: Record calibration points along sensing string in accordance with manufacturer's procedures. Provide sensor cables not in containment piping with cable tags every 50 feet.

E. Direct Buried of Hydrocarbon Sensing Cable:

   A. Replace cable damaged during installation.
   B. Seal cable ends to prevent moisture ingress.
   C. Install cable so connectors are accessible in junction boxes at grade or in manholes, valve pits or other locations.
   D. Install cable from underground to grade using PVC pipe.
   E. Install on prepared bedding.
   F. Backfill cable with 6 inches of sand placed on top of cable and compacted prior to pipe installation.
   G. Where cable is to be covered by concrete or other structures, install sensor cable in slotted PVC pipe. Install with access points to allow replacing and servicing.

F. Install Work in accordance with Authority Having Jurisdiction requirements

3.10 INSTALLATION OF PIPING SPECIFIC TO FUEL OIL

A. Install supply, return, fill, and vent piping at a uniform grade of 3 inch in ten feet downward in the direction of the storage tank.

3.11 INSTALLATION OF PIPING SPECIFIC TO DRAINAGE AND VENT SYSTEMS

A. Service Entrance Piping

   A. Extend building storm drain piping and connect to building storm sewer piping of size and in location indicated for service entrance to building. Install cleanout and extension to grade at connection of building storm drain and building storm sewer.

B. Extend building sanitary drain piping and connect to sanitary sewer piping of size and in location indicated for service entrance to building. Install cleanout and extension to grade at connection of building sanitary drain and building sanitary sewer.
C. Install sleeve and mechanical sleeve seal at service penetrations through foundation wall for watertight installation.

B. General

A. Make changes in direction for drainage and vent piping using appropriate Y branches, Y branches with 1/8 bends, and long-sweep 1/4, 1/5, 1/6, 1/8, and 1/16 bends. Sanitary tees and short-sweep quarter vends may be used on vertical stacks of drainage lines where change in direction of flow is from horizontal to vertical. Use long-turn double-Y-branch and 1/8-bend fittings where 2 fixtures are installed back to back or side by side and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. Make no change in direction of flow greater than 90°. Where different sizes of drainage pipes and fittings are connected, use proper size standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.
B. Lay buried building drains beginning at low point of each system, true to grades and alignment indicated, with unbroken continuity of invert. Place hub or bell ends of piping facing upstream. Install required gaskets according to manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in piping and pull past each joint as completed.
C. Install sanitary piping, storm water piping, condensate drain piping, and vent piping at 2% slope, except where another slope is indicated.
D. Install underground PVC drainage piping according to ASTM D2321.

a. Rigid plastic and hubless drainage piping, including offsets and jumps, shall rest on a continuous bed of sand, gravel or crushed stone, a minimum of four (4) inches deep below the pipe; maximum aggregate size shall be three-quarter (3/4) inches (MD #6 and smaller). Bedding material shall be placed on both sides of the pipe equal in depth to the pipe diameter and hand compacted to prevent deformation of pipe from top loading. Piping shall be laid in a trench, except where soil conditions or grade do not permit such practices.
b. Drainage piping above grade and not fully confined within a trench shall rest on bedding material at least thirty (30) inches wide. Horizontal and vertical alignment of piping shall be maintained by three-eighths (3/8) inch minimum diameter steel "J" hooks, "U" hooks or equivalent hold-down devices driven into the ground every eight (8) feet, at changes of direction 45° or more, and at ends of runs. The length of hold-down devices shall be sufficient, depending on soil type, to prevent easy removal, but not less than twenty-four (24) inches long.

E. Sleeves are not required for cast-iron soil pipes passing through concrete slab, without membrane waterproofing, on grade.
F. Install PVC drainage pipe and fittings according to ASTM D2665.
G. Install all buried plastic pipe in accordance with ASTM D2321.
H. Joint Construction

a. Grooved Pipe and Grooved-Pipe Fittings Joints: Assemble joints with coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
b. PVC DWV Pipe: Join PVC drainage pipe and fittings according to ASTM D2665.
c. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F402, for safe handling during joining of plastic pipe and fittings with solvent cements.

I. Pipe Attachments:

a. Riser Clamps: MSS Type 8 or Type 42 for vertical runs.
b. Adjustable Steel Clevis Hangers: MSS Type 1 for individual straight horizontal runs 100 feet and less.
c. Adjustable Roller Hangers: MSS Type 43 for individual straight horizontal runs longer than 100 feet.
d. Spring Cushion Rolls: MSS Type 49, where indicated, for individual straight horizontal runs longer than 100 feet.
e. Pipe Rolls: MSS Type 44 for multiple straight horizontal runs 100 feet or longer. Support pipe rolls on trapeze.
f. Spring Hangers: MSS Type 52 for support of base of vertical runs.

J. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to the manufacturer's written instructions.
K. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
L. Install Sweet Air odor eliminator vent caps on all sanitary vent terminations. Maintain 1-inch clearance between vent pipe and roof substrate.

C. Connections

A. Drainage Runouts to Fixtures: Provide drainage and vent piping runouts, with approved trap, of sizes indicated, but not smaller than required by plumbing code, to plumbing fixtures and drains.
B. Locate drainage piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.
C. Supply Runouts to Fixtures: Install hot- and cold-water supply piping runouts to fixtures of sizes indicated, but not smaller than required by plumbing code.

a. Drainage Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated, but not smaller than required by plumbing code.
b. Locate drainage piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.
c. Interceptor Connections: Connect piping, flow control fittings, and accessories as indicated.
1) Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow control fitting and vent on unit inlet piping; and gravity drawoff and suction piping to oil storage tank.
d. Electrical Connections: Power wiring and disconnect switches are specified in Division 26.
1) Grounding & Bonding for Electrical Systems: Connect unit components to ground according to the National Electrical Code and Specification Section "Grounding."

D. Protection

A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
B. Place plugs in ends of uncompleted piping at end of day or when work stops.
C. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of a water-based latex paint.

E. Drainage And Vent System Specialties

A. Install backwater valves in building drain piping as indicated. For interior installation, provide cleanout deck plate (cover) flush with floor and centered over backwater valve cover and of adequate size to remove valve cover for service.
B. Install expansion joints on vertical risers, stacks, and conductors as indicated.
C. Cleanouts

a. Install cleanouts in above-ground piping and building drain piping as indicated, and where not indicated, according to the following:
1) Size same as drainage piping up to 4-inch size. Use 4-inch size for larger drainage piping except where larger size cleanout is indicated.
2) Locate at each change in direction of piping greater than 45°.
3) Locate at minimum intervals of 50 feet for piping 4 inches and smaller and 100 feet for larger piping.
4) Locate at base of each vertical soil or waste stack.
b. Install cleanout deck plates (covers), of types indicated, with top flush with finished floor, for floor cleanouts for piping below floors.
c. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
d. Install flashing flange and clamping device with each stack and cleanout passing through floors having waterproof membrane.

D. Floor Drain Installation

a. Install floor drains according to manufacturer's written instructions, in locations indicated.
b. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor.
c. Trap drains connected to sanitary building drain. Provide trap primers for all traps.
d. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
e. Position drains for easy accessibility and maintenance.

E. Roof Drain Installation

a. Install roof drains at low points of roof areas, according to the roof membranes manufacturer's installation instructions.
b. Install drain flashing collar or flange so no leakage occurs between roof drain and adjoining roofing. Maintain integrity of waterproof membranes, where penetrated.
c. Position roof drains for easy accessibility and maintenance.

F. Interceptor Installation

a. General: Comply with unit manufacturer's written instructions and with local authority
1) Coordinate oil storage tank and gravity drain with Division 23 Section: "Facility Fuel Storage Tanks."
b. Flush with Floor Installation: Set unit and extension when required, with cover flush with finished floor.
c. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.

G. Flashing Installation

3.12 FIELD QUALITY CONTROL

A. Division 01 Section: “Quality Requirements”: Field inspecting, testing, adjusting, and balancing.

B. Testing shall be performed by Installer of system being tested in presence of the Owner’s representative. Provide seven (7) day advance notice prior to testing of systems.

C. Inspection of Piping Systems:

A. Do not enclose, cover, or put into operation any piping system until it has been inspected and approved by Owner’s Representative.
B. During progress of installation, notify the authority having jurisdiction seven (7) days prior to time such inspection must be made. Perform tests specified in presence of Owner’s Representative.

a. Roughing-In Inspection: Arrange for inspection of piping system after system roughing-in, before concealing, and prior to setting fixtures.
b. Final Inspection: Arrange for final inspection by Owner’s Representative to observe tests specified below and to ensure compliance with requirements of Owner’s Representative.

C. Re-inspections: Make required corrections and arrange for reinspection by Owner’s Representative when piping system fails to pass test or inspection.
D. Reports: Prepare and submit inspection reports for approval by Owner’s Representative.

D. Test domestic water, sanitary waste, vent, and storm drainage piping systems in accordance with all applicable codes and the local authority having jurisdiction.

E. Field Testing Leak Detection System:

A. Perform tests to demonstrate ability of system to detect and locate breaks, shorts and probes on sensor string.
B. Perform leak testing in accordance with the following procedure to verify operation and ability to work with condensation pools or other static moisture:

a. Wet sensor cable near start of sensor string and acknowledge detection or location alarm and recheck system.
b. Wet sensor cable near end of sensor string with first location still wetted and acknowledge detection or location alarm and recheck system.
c. Wet sensor cable in three additional locations between first and second leak locations with each detection or location alarm being acknowledged and prior leak locations still wetted.

C. Prepare and submit report verifying each leak location and detection accuracy. Furnish history print out of test results from panel. Submit TDR traces for each test run to allow verification of wet locations.

F. Leak Testing

A. Fuel Oil

a. Test oil piping as follows:
   1) After installation and before being covered, or concealed, piping shall be tested for leaks. Piping shall be tested pneumatically with air at not less than 1 1/2 times its maximum working pressure, but not less than 5 psig measured at the highest point of the system.
   2) The test shall be made so as not to impose a pressure of more than 10 psig on any tank connected to the piping.
   3) Pressure shall be maintained for at least 30 minutes or for sufficient time to complete visual inspection of all joints and connections.
   4) Suction lines shall be permitted to be tested under a vacuum of not less than 20 in. Hg maintained for at least 30 minutes.
   5) Where the vertical length of the fill and vent pipes is such that, when filled with liquid, the static head imposed exceeds 10 psig, the piping shall be tested hydrostatically to a pressure equal to the static head thus imposed.

b. General:
   1) Prior to acceptance and initial operation, all piping installations shall be inspected and pressure tested to determine that the materials, design, fabrication, and installation practices comply with the requirements of this specification.
   2) Inspection shall consist of visual examination, during or after fabrication, assembly, or pressure tests as appropriate.
   3) A piping system shall be tested as a complete unit or in sections. Under no circumstances shall a valve in a line be used as a bulkhead between gas in one section of the piping system and test medium in an adjacent section, unless two valves are installed in series with a valved “tell tale” located between these valves. A valve shall not be subjected to the test pressure unless it can be determined that the valve, including the valve closing mechanism, is designed to safely withstand the pressure.

c. Test Medium: The test medium shall be an inert gas. OXYGEN SHALL NEVER BE USED.

d. Test Preparation:
   1) Pipe joints, including welds, shall be left exposed for examination during the test.
   2) Expansion joints shall be provided with temporary restraints, if required, for the additional thrust load under test.
   3) Appliances and equipment that are not to be included in the test shall be either disconnected from the piping or isolated by blanks, blind flanges, or caps. Flanged joints at which blinds are inserted to blank off other equipment during the test shall not be required to be tested.
   4) Where the piping system is connected to appliances, equipment, or equipment components designed for operating pressures of less than the test pressure, such appliances, equipment or equipment components shall be isolated from the piping system by disconnecting them and capping the outlet(s).
   5) Where the piping system is connected to appliances, equipment, or equipment components designed for operating pressures equal to or greater than the test pressure, such appliances and equipment shall be isolated form the piping system by closing the individual equipment shutoff valves(s).
   6) All testing of piping systems shall be done with due regard for the safety of employees and the public during the test. Bulkheads, anchorage, and bracing suitably designed to resist test pressures shall be installed if necessary. Prior to testing, the interior of the pipe shall be cleared of all foreign material.

e. Test Pressure:

1) Test pressure shall be measured with a manometer or with a pressure measuring device designed and calibrated to read, record, or indicate a pressure loss due to leakage during the pressure test period. The source of pressure shall be isolated before the pressure tests are made.
2) The test pressure to be used shall be no less than 12 times the proposed maximum working pressure, but not less than 3 psi and no more than 125 psig.
3) Test duration shall be not less than 4 hours.

f. Detection of Leaks and Defects:
1) The piping system shall withstand the test pressure specified without showing any evidence of leakage or other defects. Any reduction of test pressures as indicated by pressure gauges shall be deemed to indicate the presence of a leak unless such reduction can be readily attributed to some other cause.
2) The leakage shall be located by means of an approved gas detector, a noncorrosive leak detection fluid, or other approved leak detection method. Matches, candles, open flames, or other methods that provide a source of ignition shall not be used.
3) Where leakage or other defects are located, the affected portion of the piping system shall be repaired or replaced and retested.

g. Purging:
1) Removal from Service: When piping is to be opened for servicing, addition, or modification, the section to be worked on shall be turned off from the gas supply at the nearest convenient point and the line pressure vented to the outdoors or to ventilated areas of sufficient size to prevent accumulation of flammable mixtures. The remaining gas in the piping shall be dispersed with an inert gas.

h. Placing in Operation: When piping full of air is placed in operation, the air in the piping shall be displaced with an inert gas, and the inert gas shall then be displaced with fuel.

i. Discharge of Purged Gases: The open end of piping systems being purged shall not discharge into confined spaces or areas where there are sources of ignition unless precautions are taken to perform this operation in a safe manner by ventilation of the space, control or purging rate, and elimination of all hazardous conditions.
Placing Equipment in Operation: After the piping has been placed in operation, all equipment shall be purged and then placed in operation.

B. Water Systems, Condensate Systems

a. Perform tests prior to installation of piping insulation.
b. Use ambient temperature water as the testing medium, except where there is a risk of damage due to freezing. Another liquid may be used if it is safe for workmen and compatible with the piping system components.
c. Use vents installed at high points in the system to release trapped air while filling the system. Use drains installed at low points for complete removal of the liquid.
d. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low pressure filling lines are disconnected.
e. Subject piping system to a hydrostatic test pressure which at every point in the system is not less than 1.5 times the design pressure. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in the system under test. Make a check to verify that the stress due to pressure at the bottom of vertical runs does not exceed either 90 percent of specified minimum yield

strength, or 1.7 times the ASE value in Appendix A of ASME B31.9, “Code For Pressure Piping, Building Services Piping.”

f. After the hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.

g. Test backflow preventors in accordance with the local plumbing code and requirements of the authority having jurisdiction.

C. Drainage And Vent Piping Systems

a. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open-jointed drain tile, test piping of plumbing drainage and venting systems on completion of roughing-in piping installation. Tightly close all openings in piping system and fill with water to 10 feet head of water. Water level shall not drop during the period from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.

b. Finished Plumbing Test Procedure: After plumbing fixtures have been set and their traps filled with water, test connections and prove gastight and watertight. Plug stack openings on roof and building drain where it leaves the building and introduce air into the system equal to pressure of 1-inch water column. Use a U tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

c. Repair leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.

d. Prepare reports for tests and required corrective action.

3.13 CLEANING (Division 22 Section: “Plumbing Piping System Cleaning and Treatment.”)

3.14 PAINTING

A. Mechanical Room Piping: All piping including insulated systems located in Mechanical Rooms and equipment spaces shall be completely painted. Refer to Division 09 Section: “Painting and Coating”, Colors shall be as selected by the Architect.

B. Touching Up: Clean field welds and abraded areas of paint. Use same materials as used for shop painting. Comply with SSPC-PA 1, “Shop, Field, and Maintenance Painting,” requirements for touching up field painted surfaces.

A. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

D. Plastic Pipe shall be painted with Exterior Grade Latex Paint. DO NOT USE EPOXY OR OIL BASE PAINTS ON PLASTIC PIPE.

E. CPVC Piping: Paint coming into contact with pipe and fittings must be chemically compatible as per FBC System Compatibility Program. For products not listed on one of these program lists, consult the product manufacturer for compatibility with CPVC.

3.15 MANUFACTURER'S FIELD SERVICES

A. Division 01 Section: “Quality Requirements”: Requirements for manufacturer’s field services.

B. Furnish factory trained representative of system supplier for 16 hours of on-site time during leak detection and location system sensor and electronics installation.

C. Furnish factory trained representative of system supplier for 16 hours of on-site time during final checkout of leak detection and location system.

END OF SECTION

SECTION 22 05 13

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, and the other sections of Division 22.

1.2 SUMMARY

A. Section includes:

1. Section includes single- and three-phase motors for application on equipment provided under other sections and for motors furnished loose to Project.
2. Source Quality Control.
3. Bearing Protection Ring.

B. Related Sections: The following Sections contain requirements that relate to this Section:

Division 22 Section: “Common Work Results for Plumbing.”

1. Division 22 Section: “Identification for Plumbing Piping and Equipment.”
2. Division 22 Section: “Plumbing Pumps.”
3. Division 26 Section: “Common Work Results for Electrical”
4. Division 26 Section: “Grounding and Bonding for Electrical Systems.”
5. Division 26 Section: “Identification for Electrical Systems.”

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”)

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generator.

C. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.4 SUBMITTALS

A. Division 01 Section: “Submittal Procedures”: Submittal Procedures.

B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

C. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

D. Comply with VOC limitations under section 099100.

E. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.

B. Testing Agency: Company who is a member of the International Electrical Testing Association and specializing in testing products specified in this section with minimum five years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section: “Product Requirements”: Product storage and handling requirements.

B. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

C. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

D. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR MOTORS

A. General: Requirements below apply to motors covered by this Section except as otherwise indicated.

1. Motors 3/4 hp and Larger: Three-phase motor as specified below.

2. Motors Smaller Than 3/4 hp: Single-phase motor as specified below

3. Frequency Rating: 60 Hz.

4. Voltage Rating: Determined by voltage of circuit to which motor is connected for the following motor voltage ratings (utilization voltages):

   a. 120 V Circuit: 115 V - motor rating.
   b. 208 V Circuit: 200 V - motor rating.
   c. 240 V Circuit: 230 V - motor rating.
   d. 480 V Circuit: 460 V - motor rating.

5. Minimum service factor shall be 1.15 and shall apply at frequency and utilization voltage at which motor is connected. Provide motors, which will not operate in service factor range when supply voltage is within 10 percent of motor voltage rating.

6. Capacity: Sufficient to start and operate connected loads at designated speeds in indicated environment, and with indicated operating sequence, without exceeding nameplate ratings. Provide motors rated for continuous duty at 100 percent of rated capacity.

7. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

8. Enclosure: Open driproof, unless otherwise specified. Provide screen over slots, where slots will permit passage of human extremities.

9. Provide adjustable motor slide base for belt driven equipment. Include adjusting bolts and locknuts.

10. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

11. Motors that operate with Variable Frequency Drives to meet the MG 1 Part 31 specifications with insulation that can withstand 1600 V peak voltage and a 1 msec rise time and improved baring lubrication for higher temperature operation

B. Minimum nominal full load efficiency for NEMA design B motors shall be as follows:

	Open Motors			Enclosed Motors		
	2-pole	4-pole	6-pole	2-pole	4-pole	6-pole
HP	3600 RPM	1800 RPM	1200 RPM	3600 RPM	1800 RPM	1200 RPM
1	77.0	85.5	82.5	77.0	85.5	82.5
1.5	84.0	86.5	86.5	84.0	86.5	87.5
2	85.5	86.5	87.5	85.5	86.5	88.5
3	85.5	89.5	88.5	86.5	89.5	89.5
5	86.5	89.5	89.5	88.5	89.5	89.5
7.5	88.5	91.0	90.2	89.5	91.7	91.0
10	89.5	91.7	91.7	90.2	91.7	91.0
15	90.2	93.0	91.7	91.0	92.4	91.7

C. Minimum full load efficiency for polyphase small electric motors shall be as follows:

	Open Motors		
	2-pole	4-pole	6-pole
HP	3600 RPM	1800 RPM	1200 RPM
0.25	65.6	69.5	67.5
0.33	69.5	73.4	71.4
0.50	73.4	78.2	75.3
0.75	76.8	81.1	81.7
1.0	77.0	83.5	82.5
1.5	84.0	86.5	83.8
2.0	85.5	86.5	No Req.
3.0	85.5	86.9	No Req.

D. Minimum full load efficiency for capacitor-start capacitor-run and capacitor-start induction-run small electric motors shall be as follows:

	Open Motors		
	2-pole	4-pole	6-pole
HP	3600 RPM	1800 RPM	1200 RPM
0.25	66.6	68.5	62.2
0.33	70.5	72.4	66.6
0.50	72.4	76.2	76.2
0.75	76.2	81.8	80.2
1.0	80.4	82.6	81.1
1.5	81.5	83.8	No Req.
2.0	82.9	84.5	No Req.
3.0	84.1	No Req.	No Req.

E. Three-phase Motors

1. NEMA MG 1, Design B, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.

2. Insulation System: NEMA Class F.

3. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

4. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay with wiring to terminal box.

5. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

6. Sound Power Levels: Conform to NEMA MG 1.

7. Multi-Speed Motors: Separate winding for each speed.

8. Variable Speed Motors for Use With Solid-State Drives: Energy efficient, squirrel-cage induction, design B units and ratings, characteristics, and features coordinated with and approved by drive manufacturer. Motors shall be labeled to indicate that they are provided with inverter duty capability in accordance with the National Electrical Manufacturers Association NEMA MG-1, Part 31.

9. Motors for Reduced Inrush Starting: Coordinate with indicated reduced controller type and with characteristics of driven equipment load. Provide required wiring leads in motor terminal box to suit control method.

10. All motors shall be provided with manufacturer's stamped nameplate, to include all pertinent and capacity data.

F. Single-phase Motors

1. General: Conform to the following requirements except as otherwise indicated.

2. Energy Efficient Motors: One of the following types as selected to suit the starting torque and other requirements of the specific motor application.

   a. Permanent Split Capacitor.
   b. Split-Phase Start, Capacitor-Run.
   c. Capacitor-Start, Capacitor-Run.

3. Shaded-Pole Motors: Use only for motors smaller than 1/20 hp.

4. Internal Thermal Overload Protection for Motors: Protection shall automatically opens the power supply circuit to the motor, or a control circuit arranged for external connection. Protection operates when winding temperature exceeds a safe value calibrated to the temperature rating of the motor insulation. Provide device that automatically resets when motor temperature returns to normal range except as otherwise indicated.

5. Bearings: Belt connected motors and other motors with high radial forces on motor shaft shall be ball bearing type. Sealed, prelubricated sleeve bearings may be used for other single phase motors.

2.2 SOURCE QUALITY CONTROL

A. Test motors in accordance with National Electrical Manufacturers Association NEMA MG 1, including winding resistance, no-load speed and current, locked rotor current, insulation high-potential test, and mechanical alignment tests.

2.3 BEARING PROTECTION RING

A. All motors driven by a variable frequency PWM drive shall include a maintenance free, circumferential, conductive micro fiber shaft grounding ring to discharge shaft currents to ground.

B. Provide AEGIS SGR Bearing Protection Ring as manufactured by Electro Statis Technology.

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect and remove abandoned motors.

B. Maintain access to existing motors and other installations remaining active and requiring access.

C. Clean and repair existing motors to remain or are to be reinstalled.

3.2 INSTALLATION

A. General: The following requirements apply to field-installed motors.

1. Install motors in accordance with manufacturer's published instructions and the following:

a. Direct Connected Motors: Mount securely in accurate alignment. Connect to driven equipment with coupler of appropriate type and material for the given duty. Coupler shall be selected for high and range of motor application.

B. Install engraved plastic nameplates in accordance with Division 26.

C. Ground and bond motors in accordance with Division 26.

3.3 FIELD QUALITY CONTROL

A. Division 01 Section: "Quality Requirements": Field inspection, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.15.

3.4 VARIABLE FREQUENCY MOTORS

A. Install Bearing Protection Ring in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 22 05 16
EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, and the other sections of Division 22

1.2 SUMMARY

A. Section includes:

1. Flexible pipe connectors.
2. Expansion joints.
3. Pipe alignment guides.
4. Swivel Joints
5. Pipe anchors.
6. Flexible Pre-Fabricated expansion loops
7. Powder-Actuated Fasteners
8. Concrete
9. Grout

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 03 Section: “Cast-in-Place Concrete”: Product and execution requirements for formwork, reinforcement, and concrete.
2. Division 22 Section: “Hangers and Supports for Plumbing Piping and Equipment”: Product and installation requirements for piping hangers and supports.
3. Division 22 Section: “Vibration and Seismic Controls for Plumbing Piping and Equipment”: Product and installation requirements for vibration isolators used in piping systems.

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”)

A. ASME (American Society of Mechanical Engineers)

1. ASME B16.20, Metallic Gaskets for Pipe Flanges- Ring-Joint, Spiral-Wound.
2. ASME B16.21, Nonmetallic Flay Gaskets for Pipe Flanges.
3. ASME B31.9, Building Services Piping.

B. AWS (American Welding Society)

1. AWS D1.1, Structural Welding Code- Steel.
2. ANSI/AWS B2.1, Standard Specification for Welding Procedure and Performance Qualification.
3. ANSI/AWS D10.12, Guide for Welding Mild Steel Pipe.

C. AWWA (American Water Works Association)

1. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

D. IMC (International Mechanical Code)

E. IPC (International Plumbing Code)

1.4 DESIGN REQUIREMENTS

A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints and adequately protect all systems.

1.5 SUBMITTALS

A. Division 01 Section: “Submittal Procedures”: Requirements for submittals.

B. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets and swing joints.

C. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

D. Design Data: Indicate criteria and show calculations. Submit sizing methods and calculations.

E. Manufacturer's Installation Instructions: Submit special procedures.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Manufacturer’s Field Reports: Indicate results of inspection by manufacturer’s representative.

H. Comply with VOC limitations under section 099100.

I. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.6 CLOSEOUT SUBMITTALS

A. Division 01 Section: “Execution and Closeout Requirements”: Closeout procedures.

B. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Operation and Maintenance Data: Submit adjustment instructions.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

B. Perform Work in accordance with all applicable codes and standards.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years experience.

B. Installer: Company specializing in performing work of this section with minimum 5 years experience.

1.9 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section: “Product Requirements”: Product storage and handling requirements.

B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.11 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for leak free performance of packed expansion joints.

1.12 EXTRA MATERIALS

A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Supply two 12 ounce containers of packing lubricant and cartridge style grease gun.

PART 2 - PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS:

A. Furnish materials in accordance with Authority Having Jurisdiction Standards

B. Steel Piping:

1. Inner Hose: Stainless Steel.
2. Exterior Sleeve: Double braided stainless steel.
3. Pressure Rating: 200 psig WOG and 250 degrees F.
4. Joint: As specified for pipe joints.
5. Size: Use pipe-sized units.
6. Maximum offset: 3/4 inch on each side of installed center line.

C. Copper Piping:

1. Inner Hose: Bronze
2. Exterior Sleeve: Braided bronze.
3. Pressure Rating: 200 psig WOG and 250 degrees F
4. Joint: As specified for pipe joints
5. Size: Use pipe sized units
6. Maximum offset: 3/4 inch on each side of installed center line

2.2 EXPANSION JOINTS

A. Furnish materials in accordance with Authority Having Jurisdiction Standards

B. Stainless Steel Bellows Type:

1. Pressure Rating: 200 psig WOG and 250 degrees F.
2. Maximum Compression: 1-3/4 inch.
3. Maximum Extension: 1/4 inch.
4. Joint: As specified for pipe joints.
5. Size: Use pipe sized units.
6. Application: Steel piping 3 inch and smaller.

C. External Ring Controlled Stainless Steel Bellows Type:

1. Pressure Rating: 200 psig WOG and 250 degrees F.

2. Maximum Compression: 1-1/4 inch.
3. Maximum Extension: 3/8 inch.
4. Maximum Offset: 1/8 inch.
5. Joint: Flanged.
6. Size: Use pipe sized units.
7. Accessories: Internal flow liner.
8. Application: Steel piping 3 inch and larger.

D. Double Sphere, Flexible Compensators:

1. Body: Neoprene and nylon.
2. Working Pressure: 125 psi.
3. Maximum Temperature: 400 degrees F.
4. Maximum Compression: 1-1/8 inch.
5. Maximum Elongation: 7/8 inch.
6. Maximum Offset: 3/4 inch.
7. Maximum Angular Movement: 15 degrees.
8. Joint: Galvanized flanges.
9. Size: Use pipe sized units.
10. Accessories: Control rods.
11. Application: Steel piping 2 inch and larger.

E. Two-ply Bronze Bellows Type:

1. Construction: Bronze with anti-torque device, limit stops, internal guides.
2. Pressure Rating: 200 psi WOG and 250 degrees F.
3. Maximum Compression: 1-3/4 inch.
4. Maximum Extension: 1/4 inch.
5. Joint: As specified for pipe joints.
6. Size: Use pipe sized units.
7. Application: Copper piping.

F. Low Pressure Compensators with two-ply Bronze Bellows:

1. Working Pressure: 75 psig.
2. Maximum Temperatures: 250 degrees F.
3. Maximum Compression: 1/2 inch.
4. Maximum Extension: 5/32 inch.
5. Joint: Soldered.
6. Size: Use pipe sized units.
7. Application: Copper or steel piping 2 inch and smaller.

G. Copper with Packed Sliding Sleeve:

1. Maximum Temperature: 250 degrees F.
2. Joint: As specified for pipe joints.
3. Size: Use pipe sized units.
4. Copper or steel piping 2 inches and larger.
5. Application: Copper or steel piping 2 inch and larger.

2.3 PIPE ALIGNMENT GUIDES

A. Furnish materials in accordance with Authority Having Jurisdiction Standards

B. Systems greater than 70°F operating temperature: Provide Erico (formerly known as Michigan) Model No. 650, or an acceptable comparable product.

C. Systems less than 70°F operating temperature: Provide Erico (formerly known as Michigan) Model No. 651, or an acceptable comparable product.

D. Style IV – Pipe Alignment Guide (Spider Type): Primary and intermediate guides shall be of the radial type employing a heavy wall guide cylinder with weld down or bolt down anchor base. A two section guide spider, having 1/8" maximum diametrical clearance with guide cylinder inside diameter, bolted or welded tight to the carrier pipe which slides through the guide cylinder I.D. Cylinder shall be of sufficient size to clear pipe insulation and long enough to prevent over travel of the spider. Pipe alignment guides shall be style "PGIV" as manufactured by The Metraflex Company, or an an acceptable comparable product.

2.4 SWIVEL JOINTS

A. Furnish materials in accordance with Authority Having Jurisdiction Standards

B. Ductile Iron body, double ball bearing race, field lubricated, with rubber o-ring seals.

2.5 PIPE ANCHORS

A. Furnish materials in accordance with Authority Having Jurisdiction Standards

B. Steel Shapes and Plates: ASTM A 36/A 36M.

C. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.

D. Washers: ASTM F 844, steel, plain, flat washers.

E. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened Portland cement concrete, and tension and shear capacities appropriate for application.

1. Stud: Threaded, zinc-coated carbon steel.
2. Expansion Plug: Zinc-coated steel.
3. Washer and Nut: Zinc-coated steel.

F. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened Portland cement concrete, and tension and shear capacities appropriate for application.

1. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
3. Washer and Nut: Zinc-coated steel.

G. Concrete: Portland cement mix, 3000 psi minimum. Refer to Division 03 Section: “Cast-in-Place Concrete” for formwork, reinforcement, and concrete.

H. Grout: Refer to Division 22 Section: “Common Work Results for Plumbing.”

2.6 FLEXIBLE PRE-FABRICATED EXPANSION LOOPS

A. Metraloop® – Flexible Expansion Loop (thermal applications):

1. Provide flexible expansion loops of size and type noted on drawings. Flexible loops shall consist of two flexible sections of hose and braid, two 90° elbows, and a 180° return assembled in such a way that the piping does not change direction, but maintains its course along a single axis. Flexible loops shall have a factory supplied, center support nut located at the bottom of the 180°return, and a drain/air release plug. Flexible loops shall impart no thrust loads to system support anchors or building structure. Loops shall be installed in a neutral, pre-compressed or pre-extended condition as required for the application. For steam service, loops must be installed with flexible legs horizontal to prevent condensate buildup. Install and guide per manufacturer’s recommendations. Materials of construction and end fitting type shall be consistent with pipe material and equipment/pipe connection fittings. For natural gas service, connectors shall be A.G.A. certified. Flexible expansion loops shall be “Metraloop®” as manufactured by The Metraflex Company®, Chicago, IL or an acceptable comparable product.

B. Metraloop® - Flexible Expansion Loop (seismic applications):

1. All equipment, either rigidly mounted or mounted on vibration isolators, shall be attached to the piping system using flexible loops designed for seismic movement. Flexible loops shall be capable of movement in the $\pm$X, $\pm$Y, and $\pm$Z planes shall completely isolate the equipment from the piping, System design engineer shall determine the amount of seismic movement required by the Uniform Building Code and/or other applicable codes.
2. All piping passing through building seismic joints shall contain flexible expansion loops designed for seismic movement. Flexible loops shall be located at, or near the building seismic joint. A vertical support hanger, located within 4 pipe diameters, shall be installed on each side of the flexible loop. Each hanger shall be transversely and longitudinally braced per local codes. Seismic bracing shall not pass through building seismic joint and shall not connect or tie together different sides or parts of building structure. Flexible loops shall be capable of move in the $\pm$X, $\pm$Y, and $\pm$Z planes. System design engineer shall determine the required amount of seismic movement required by the Uniform Building Code and/or other applicable codes.
3. Flexible loops attached to fuel gas lines, shall be specifically manufactured for fuel gas applications and certified by the American Gas Associate. Flexible loops connected to medical gas piping shall be specifically manufactured for medical gas and installed by a certified installer. Unless specified otherwise by system design engineer or governing codes, all flexible loop connections to medical gas piping shall be cleaned, installed, inspected, and tested in accordance with current NFPA-99 standards.
4. Flexible expansion/seismic loops shall consist of two flexible sections of hose and braid, two 90° elbows, and a 180° return assembled in such a way that the piping does not change direction, but maintains its course along a single axis. Flexible loops shall have a factory supplied, center support nut located at the bottom of the 180° return, and a drain/air release plug. Flexible loops shall impart no thrust loads to system support anchors or building structure. Flexible loops may be installed to accommodate both thermal and seismic motion. For steam service, loops shall be installed with flexible legs

horizontal to prevent condensate buildup. Materials construction and end fitting type shall be consistent with pipe material and equipment/pipe connection fittings. Movement capabilities and location, relative to seismic separation, shall be determined by system design engineer and manufacturers recommendations. Flexible expansion/seismic loops to be the “Metraloop®” as manufactured by The Metraflex Company®, Chicago, IL. or an acceptable comparable product.

2.7 Powder-Actuated Fasteners: Attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

2.8 Concrete: Portland-cement mix, 3000 psi:

A. Cement: ASTM C150, Type I.

B. Fine Aggregate: ASTM C33, sand.

C. Coarse Aggregate: ASTM C33, crushed gravel.

D. Water: Potable.

2.9 Grout: ASTM C 1107, Grade B, non-shrink, nonmetallic:

A. Characteristics include post-hardening volume-adjusting dry hydraulic-cement-type grout that is non-staining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.

B. Design Mix: 5000 psi, 28-day compressive strength.

C. Water: Potable.

D. Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Work in accordance with ASME B31.1, ASME B31.5, and ASME B31.9.

B. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Refer to Division 22. Provide line size flexible connectors.

C. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

D. Rigidly anchor pipe to building structure. Provide pipe guides to direct movement only along axis of pipe. Erect piping so strain and weight is not on cast connections or apparatus.

E. Provide support and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required. Refer to Division 22 for pipe hanger installation requirements.

F. Provide grooved piping systems with minimum one joint per inch pipe diameter instead of flexible connector supported by vibration isolation. Grooved piping systems need not be anchored.

G. Provide expansion loops as indicated on Drawings.

H. Pipe Expansion Joint Installation:

1. Install pipe expansion joints according to manufacturer's written instructions.
2. Align expansion joints to avoid end-loading and torsional stress.

I. Fabricated-type Pipe Expansion Compensation Installation:

1. Install pipe expansion loops cold-sprung in tension or compression as required to absorb 50 percent of total compression or tension that will be produced during anticipated change in temperature.
2. Connect risers to mains with at least 5 pipe fittings including tee in main.
3. Connect risers to terminal units with at least 4 pipe fittings including tee in riser.

J. Pipe Alignment Guide Installation:

Install pipe alignment guides on piping that adjoins pipe expansion joints.

1. Install pipe alignment guides on piping that adjoins pipe expansion loops.
2. Install pipe alignment guides on piping elsewhere as indicated.
3. Secure pipe alignment guides to building substrate.

K. Pipe Anchor Installation:

1. Install pipe anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9, and to prevent transfer of loading and stresses to connected equipment.
2. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS D1.1.
3. Construct concrete pipe anchors of poured-in-place concrete of dimensions indicated, include embedded fasteners.
4. Where pipe expansion joints are indicated, install pipe guides according to expansion unit manufacturer's written instructions to control movement to compensators.
5. Pipe Anchor Spacings: Where not otherwise indicated, install pipe anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends. Preset anchors as required to accommodate both expansion and contraction of piping.
6. Use grout to form flat bearing surfaces for pipe expansion joints, pipe alignment guides, and pipe anchors that are installed on or in concrete.

3.2 FIELD QUALITY CONTROL

A. Division 01 Section: “Quality Requirements”: Manufacturer’s field services.

B. Certified Manufacturer's Installation Report: Flexible pipe manufactured representative shall prepare a certified report covering installation of pipe expansion joints, pipe alignment guides, and pipe anchors, and that all performing satisfactorily.

END OF SECTION

SECTION 22 05 23
GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, and the other sections of Division 22.

1.2 SUMMARY

A. Section includes:

1. Globe valves
2. Check valves.
3. Ball valves.
4. Butterfly valves.
5. Drain valves.
6. Lubricated plug valves.
7. Valving specialties.
8. Trap priming systems.
9. Multi-purpose valves.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 22 Section: “Common Work Results for Plumbing.”
2. Division 22 Section: “Hangers and Supports for Plumbing and Equipment”: Product and installation requirements for pipe hangers and supports.
3. Division 22 Section: “Vibration and Seismic Controls for Plumbing Piping and Equipment.”
4. Division 22 Section: “Plumbing Insulation”: Product and installation requirements for insulation for valves.
5. Division 22 Section: “Pipes and Tubes for Plumbing and Equipment”: Product and installation requirements for piping materials applying to various system types.

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”)

A. References listed in this section:

1. ANSI (American National Standards Institute)
    a. ANSI/ASME B16.34, Valves-Flanged, Threaded, and Welding End.
    b. ANSI/API 600, Bolted Bonnet Steel Gate Valves for Petroleum and Natural Gas Industries.
2. ASME (American Society of Mechanical Engineers)

a. ASME A112.14.1, Back Water Valves.
b. ASME B16.10, Face to Face and End to End Dimensions of Valves.

3. ASSE (American Society of Sanitary Engineers)

a. ASSE 1013 Reduced Pressure Principle Backflow Preventors.
b. ASSE 1015, Double Check Backflow Prevention Assembly.
c.

4. ASTM (American Society for Testing and Materials)

a. ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
b. ASTM A182, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
c. ASTM B61, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
d. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

5. IBC (International Building Code)
6. CSA (Canadian Standards Association)
7. IEEE (Institute of Electrical and Electronics Engineers)
8. IMC (International Mechanical Code)
9. IPC (International Plumbing Code)
10. MOSHA (Maryland Occupational Safety and Health Administration)
11. MSS (Manufacturers Standards Society of the Valve & Fittings Industry)

a. MSS SP-25, Standard Marketing System for Valves, Fittings, Flanges and Unions.
b. MSS SP-45, Bypass Drain Connections.
c. MSS SP-55, Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components.
d. MSS SP-61, Pressure Testing of Steel Valves.
e. MSS SP-67, Butterfly Valves.
f. MSS SP-68, High-Pressure Butterfly Valves with Offset Design.
g. MSS SP-70, Cast Iron Gate Valves Flanged and Threaded Ends.
h. MSS SP-71, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
i. MSS SP-72, Ball Valves with Flanged Fitting.
j. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
k. MSS SP-80, Bronze Gate, Globe, Angle and Check Valves.
l. MSS SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.
m. MSS SP-110, “Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

12. NEC (National Electrical Code)
13. NEMA (National Electrical Manufacturers Association)
14. NSF/ANSI 61 & Annex G – Drinking Water Systems Components – Health Effects
15. NSF/ANSI 372 – Drinking Water Systems Components – Lead Content
16. OSHA (Occupational Safety and Health Administration)
17. UL (Underwriters' Laboratories)

1.4 DEFINITIONS

A. Lead Free:

1. The pipes, pipe fittings, plumbing fittings or fixtures in plumbing systems that are intended to dispense potable water for human consumption, including drinking and cooking, shall be “lead free”, containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.
2. Solder and flux for soldered joints in potable water piping shall be “lead free”, containing not more than 0.2% lead.

1.5 SUBMITTALS

A. Division 01 Section: “Submittal Procedures”: Requirements for Submittals.

B. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.

C. Manufacturer's Installation Instructions: Submit hanging, support methods, and joining procedures.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Comply with VOC limitations under section 099100.

F. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.6 CLOSEOUT SUBMITTALS

A. Division 01 Section: “Execution and Closeout Requirements”: Requirements for Submittals.

B. Project Record Documents: Record actual locations of valves.

C. Operation and Maintenance Data: Submit installation instructions, spare parts list, explained assembly views.

1.7 QUALITY ASSURANCE

A. Valves shall be provided by the same manufacturer when applicable.

B. Grooved end valves shall be of the same manufacturer as the adjoining couplings.

C. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

D. Material shall be certified by NSF International as complying with NSF 14, NSF 61, NSF 372 and ASTM F 2389 or CSA B137.11.

E. Material shall comply with manufacturers specifications.

F. Material and installation shall be in accordance with NFPA 99, and as specified.

G. Perform work in accordance with AHJ requirements.

H. Special Engineered products shall be certified by NSA International as complying with NSF 14.

I. Lead Free:

1. Valves in plumbing systems that are intended to dispense potable water for human consumption, including drinking and cooling, shall be “lead free” containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.
2. Solder and flux for soldered joints in potable water piping shall be “lead free”, containing not more than 0.2% lead.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing work of this section with minimum 5 years experience.

1.9 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section: “Product Requirements”: Requirements for transporting, handling, storing and protecting products.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Prepare for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Set globe and gate valves closed to prevent rattling.
3. Set ball and plug valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.

E. Use the following precautions during storage:

1. Store indoors and maintain temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store off the ground in watertight enclosures.

F. Use a sling to handle large valves. Rig to avoid damage to exposed parts. Do not use handwheels and stems as lifting or rigging points.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section: “Product Requirements”: Environmental Conditions affecting products on site.

B. Do not install valves underground when bedding is wet or frozen

1.12 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish five year manufacturer warranty for valves excluding packing.

1.13 EXTRA MATERIALS

A. Division 01 - Execution and Closeout Requirements: Requirements for extra materials.

B. Furnish two packing kits for each size valve.

PART 2 - PRODUCTS

2.1 VALVES - BASIC, COMMON FEATURES

A. Pressure and Temperature Ratings: As indicated in the “Application Schedule” of Part 3 of this Section and as required to suit system pressures and temperatures.

B. Sizes: Same size as upstream pipe, unless otherwise indicated.

C. Operators: Use specified operators and handwheels, except provide the following special operator features:

1. Chain-Wheel Operators: For valves 3 inches and larger, installed 120 inches or higher above finished floor elevation.
2. Lever Operators: Ball and butterfly valves 10" and less.

D. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

E. Threads: ANSI/ASME B1.20.1.

F. Flanges: ASME B16.1, ASME B16.5, and ASME B16.24.

G. Hexagonal Threaded Packing Adjustment: All ball valves.

H. Bypass and Drain Connections: Comply with MSS SP-45.

I. Memory Stops: Provide memory stops for all “Balancing” valves.

2.2 VALVE APPLICATION SCHEDULE:

A. Domestic Water:

1. Globe Valves:

a. 1/8” through 2":

1) Globe valves shall be class 250# CWP, rising stem, threaded bonnet, body with integral seat. The body, bonnet, union nut, disc holder & stem shall be ASTM B584 C89833, cast bronze (1/4” through 3/4” disc holder ASTM B16.) Bronze Disc. Hand wheel shall be Malleable iron. MSS SP-80, Type 2. Basis of Design:
Milwaukee Model: UP502 (Threaded)
Milwaukee Model: UP1502 (Sweat)
Conbraco Industries; Apollo Model 120 TF (Threaded)
Conbraco Industries; Apollof Model – 120 SLF (Sweat)

2) Design valves in accordance with requirements of ANSI NSF-372, Senate law S.3874.

b. 2 ½” through 10":

1) Globe valves shall be class 125# SWP, 200# CWP, rising stem, bolted bonnet. Body, bonnet, & Handwheel shall be ASTM A126, Class B cast iron. Stem & Packing Gland shall be ASTM B16, Brass. Seat Ring, Disc through 3” or disc ring for 4” through 10,” yoke bushing, & swivel nut shall be cast ASTM B62, Bronze. 125 Lb. flanged ends. Packing will be Aramid Fiber & Graphite with a Neoprene binder for service up to 550°F, MSS SP-85. Basis of Design:
Conbraco Industries; Apollo Model – 711F - LF

2) Design valves in accordance with requirements of ANSI NSF 372, Senate law S.3874.

2. Check Valves:

a. Horizontal Swing ¼” through 2”:

1) Check valves shall be class, 200# CWP, horizontal swing check, body with 5° integral seat. Body, cap, & Disc shall be of ASTM, B584 C89833 cast bronze. (Disc on ¼” through ¾” ASTM B16) Lever, retaining ring, and Hinge Pin shall be stainless steel. Plug shall be ATSM B16, Lever, MSS SP-80, Type 3. Basis of Design:

Milwaukee Model: UP509 (Threaded)
Milwaukee Model: UP1509 (Sweat)
NIBCO Model: T413-Y-LF (Threaded)
NIBCO Model: S413-Y-LF (Sweat)
Conbraco Industries; Apollo Model – 163T-LF (Threaded)
Conbraco Industries; Apollo Model – 163S-LF (Sweat)

2) Design valves in accordance with requirements of ANSI NSF-372, Senate law S.3874.

b. Horizontal Swing- 2 ½" through 12":

1) Check valves shall be class 125# SWP, 200# CWP, horizontal swing Check. Body, bonnet, Hanger & disc shall be of ASTM A536, Class B cast iron. Hanger Pin, disc nut, & side plug shall be ASTM B16, Brass. Seat Ring & Disc or disc Face Ring of ASTM A126 Class B, Bronze. 125 Lb. flanged ends. bolted bonnet. MSS SP-71, Type 1. Basis of Design:
Milwaukee Model: F-2974 M26
Conbraco Industries; Apollo Model – 910F-LF

2) Design valves in accordance with requirements of ANSI NSF-372, Senate law S.3874.

c. Spring Loaded "Silent" Lift- 3/8" through 2":

1) Check valves shall be 250# CWP. ASTM B584 C89833, cast bronze body with integral seat, Tail Piece, & center guided disc holder. ASTM B104, bronze Spring. Buna or PTFE disc ring. Basis of Design:
Milwaukee Valve Figure Number UP548B (Threaded)
Milwaukee Valve Figure Number UP1548T (Sweat)
NIBCO Model: T480-Y-LF (Threaded)
NIBCO Model: S480-Y-LF (Sweat)
Conbraco Industries; Apollo Model – 61F-500 (Threaded)
Conbraco Industries; Apollo Model – 61F-600 (Sweat)
Other manufacturers: Hammond, Lunkenhimer

2) Design valves in accordance with requirements of California AB1953 and Vermont S152.

d. Wafer Style "Silent"- 2 1/2" through 10":

1) Check valves shall be Wafer style Class 125, 200 PSIG CWP minimum. (2 ½" through 6" shall be combination ANSI 125 & 250 class valves using ANSI class 125 dimensions) Body shall be of ASTM A126, Class B cast iron. Stainless steel plug, bushing, & seat ring. Stainless Steel spring and seat ring screws. Basis of Design:

Milwaukee Model: 1400 Series
NIBCO Model: W910-B
Other manufacturers: Hammond, Lunkenhimer

2) Design valves in accordance with requirements of ANSI NSF 372 Senate Law S.3874

3. Ball Valves:

a. ¼" through 2":

1) Ball valves shall be 600 CWP, ASTM B584 C89833, cast bronze two piece adapter loaded single reduced bore with chrome plated solid ASTM B16, brass tunnel drilled ball, blow-out proof brass stem, RPTFE 15% glass filled seats & thrust washer, PTFE packing, hexagonal threaded packing nut of ASTM B16, brass, Lever handle of Zinc plated steel with vinyl handle grip, MSS SP-110. Fed. Spec. WW-V-35C II, BZ, 3. Basis of Design:

Milwaukee Model: UPBA100 (Threaded)
Milwaukee Model: UPBA150 (Sweat)
NIBCO T/S 685-80-LF
Conbraco Industries; Apollo Model – 70LF 100 (Threaded)
Conbraco Industries; Apollo Model – 70LF 200 (Sweat)

2) Design valves in accordance with requirements of ANSI NSF 372, Senate Law S. 3874.

b. 3 Piece- ¼" through 3":

1) Ball valves shall be 600# CWP, ASTM B584 C899833, cast bronze three piece, exposed bolt design, full bore, chrome plated solid ASTM B16, brass tunnel drilled ball, blow-out proof brass stem, one piece RPTFE 15% glass filled seat and body seal, 25% glass filled RPTFE thrust washer, PTFE packing, hexagonal threaded packing nut of ASTM B16, brass, Grade 8 Zinc plated steel body bolts & nuts, Lever handle of Zinc plated steel with vinyl handle grip, MSS SP-110. Fed. Spec. WW-V-35C II, BZ, 1. Basis of Design:

Milwaukee Model: UPBA-300-A (Threaded)
Milwaukee Model: UPBA-350-A (Sweat)
NIBCO Model: T595-Y-LF (Threaded)
NIBCO Model: S595-Y-LF (Sweat)
Conbraco Industries; Apollo Model – 82LF 100 (Threaded)
Conbraco Industries; Apollo Model – 82LF 200 (Sweat)

2) Design valves in accordance with requirements of ANSI NSF 372, Senate Law S. 3874.

3) Victaulic Series P569, stainless steel ball valve with Vic-Press ends, full port, pressure rating to 400-psig CWP. UL classified in accordance with NSF-61 for potable water service. The system shall meet the low-lead requirements of NSF-372.

c. CPVC: 2 inches and Smaller:
1) 150 psi at 73 degrees F water temperature, maximum service temperature: 210 degrees F, ASTM D1785, CPVC body and ball, double lever handle, EPDM seals, Teflon seals, full port, double union type with socket ends

4. Butterfly Valves:

   a. 3” through 48":
      1) Materials & Construction:
         a) Butterfly valves shall be, Cast Iron ASTM A126, Class B Lug Style Body with through tapped lugs. Valves shall be suitable for “Dead End Service”. Elastomer seat will be made of EPDM, ASTM D2000, suitable for continuous operation from 30°F through + 250°F, ASTM B148, Alloy 954 Aluminum Bronze or Nyon-11 coated Disc with a Broached Stem to Disc Drive Connection. (14” & larger valves to have a plug & pin stem to disc connection) Upper & Lower Blowout proof stems of ASTM A582, Type 416 Stainless Steel. Buna N “O” Ring stem and Dirt seals, 2”+ extended neck to accommodate insulation. Valves to be “Bubble Tight” up to the maximum rated working pressure in either direction. Valves to be factory tested for “Bubble Tight” shut off in accordance with ANSI Class 6. Zero leakage preferred.
         b) Maximum Rated Working Pressure:
            (1) For 3” through 12” valves is 200 PSIG
         c) Actuator / Operator:
            (2) For all valves 3” through 6” use a 10 position Lever handle with locking Trigger.

   b. 2-1/2” – 6, 300psi maximum pressure rating with copper tubing sized grooved ends. Cast brass body to UNSC87850. (Alloy code shall be cast or stamped into the valve body.) Aluminum bronze disc to UNS C95500, with pressure responsive elastomer seat. Stem shall be offset from the disc centerline to provide complete 360 – degree circumferential seating. Bubble tight, dead-end or bi-directional service, with memory stops for throttling, metering or balancing service. Valve may be automated with electric, pneumatic, or hydraulic operators. Certified to the low lead requirements of NSF-372 Victaulic Series 608N.

   c. Design valves in accordance with requirements of ANSI NSF 372, Senate Law S. 3874.

   d. CPVC – 2 inches through 10 inches: 150 psi at 73 degrees F water temperature, maximum service temperature: 140 degrees F, one piece body, ASTM D1785 PVC, lig type flange, facing disc encapsulated with EPDM, stainless steel shaft, locking lever handle.

5. Hose End Drain Valves ½” and ¾”:

   a. Hose end drain valves shall be class 600# CWP, ASTM B584, cast bronze two piece adapter loaded single reduced bore with chrome plated solid ASTM B16, brass tunnel drilled ball, blow-out proof brass stem, RPTFE 15% glass filled seats & 25% glass filled thrust washer, PTFE packing, hexagonal threaded packing nut of ASTM B16, brass, Lever handle of Zinc plated steel with vinyl handle grip, ASTM B16, brass tail piece with standard hose end threads, brass bead chain and Zinc die cast cap, MSS SP-110, Fed. Spec. WW-V-35C II, BZ, 3. Basis of Design:

Conbraco Industries; Apollo Model – 70 HCLF
Milwaukee Model: UPBA 100 H (Threaded)
Milwaukee Model: UPBA 150 H (Sweat)
NIBCO Model: T585-70-HC (Threaded)
NIBCO Model: S585-70-HC (Sweat)

b. Design valves in accordance with requirements of ANSI NSF 372, Senate Law S. 3874.

B. Fuel Oil:

1. Ball Valves:

a. ¼" through 2" Ball valves shall be 600 CWP, ASTM B584, cast bronze two piece adapter loaded single reduced bore with ASTM A276, type 316 Stainless Steel solid tunnel drilled ball vented from the body cavity to the tunnel of the ball, blow-out proof ASTM A276, type 316 Stainless Steel stem, -02 RPTFE seats rated for 250 PSIG @ 100°F, multiple piece "V" ring PTFE packing. PTFE thrust washer, & body/tail piece seal, hexagonal threaded gland follower, Type 304 stainless steel tamper proof latch lock lever handle. Two bolt actuator mounting pad, Threaded end, MSS SP-110. Basis of Design:

Milwaukee Model: 20BSOR-O2-LL (Threaded)
Conbraco Industries; Apollo Series 70
NIBCO T 585-70-66-UL

b. Three Piece ¼" through 2" Ball valves shall be 1,000# CWP @ 150°F, ASTM A216, grade WCB cast carbon steel OR ASTM A351, grade CF8M cast stainless steel, three piece, enclosed bolt design, Single Reduced Bore, ASTM A276, type 316 Stainless Steel solid tunnel drilled ball vented from the body cavity to the tunnel of the ball, blow-out proof ASTM A276, type 316 Stainless Steel stem, -02 RPTFE seat and body seal rated for 1,000 PSIG @ 150°F, Live Loaded multiple piece Grafoil packing. RPTFE thrust washer, Type 304 stainless steel tamper proof latch lock lever handle. Three bolt actuator mounting pad integral with center section of valve body, Threaded or Socket Weld ends, API 607, fire tested, ANSI B16.34, ANSI/ASME B16.5, ANSI/ASME B16.10, WW-V-35B, MSS SP-110. Basis of Design:

Single Reduced Bore Threaded End:
Milwaukee Model: 35CSOF-02-LL (Carbon Steel)

Single Reduced Bore Socket Weld End:
Milwaukee Model: 35CS1F-02-LL (Carbon Steel)
NIBCO T 595 CSR/S6R-66-LL
Conbraco Industries; Apollo Model – 83A (Carbon Steel)

c. 2 ½" Ball valves shall be ANSI class 900 wall thickness and rated for 1500# CWP @ 375°F, ASTM A216, grade WCB cast carbon steel OR ASTM A351, grade CF8M cast stainless steel, seal welded to form a one piece body, ASTM A276, type 316 Stainless Steel solid tunnel drilled ball vented from the body cavity to the

tunnel of the ball, Blow-out proof ASTM A276, type 316 Stainless Steel stem, -02 RPTFE seats rated for 1,500 PSIG (CWP) @ 375°F, multiple piece graphite packing, RPTFE thrust washer, hexagonal threaded gland follower, Type 304 stainless steel tamper proof latch lock lever handle. Four bolt actuator mounting pad. Threaded or socket weld end, API 607, fire tested, ANSI B16.34, ANSI/ASME B16.5, ANSI/ASME B16.10, WW-V-35B, MSS SP-110. Basis of Design:

Full Bore Threaded End:
Milwaukee Model: 41CS0F-02-LL (Carbon Steel)
Milwaukee Model: 41SSOF-02-LL (Stainless Steel)

Full Bore Socket Weld End:
Milwaukee Model: 41CS1F-02-LL (Carbon Steel)

d. Flanged End Uni Body- 2 ½" through 6" Ball valves shall be ANSI class 150 Lb., Uni-body, Single reduced bore. Body of ASTM A216, grade WCB cast carbon steel OR ASTM A- grade CF8M cast stainless steel. 150 Lb. Flanged ends, ASTM A276, type 316 stainless steel blow-out proof grounded stem, ASTM A276, type 316 stainless steel solid tunnel drilled ball vented from the body cavity to the tunnel of the ball. Multiple piece Graphite packing. PTFE thrust washer, & body/ball retainer seal, two bolt packing adjustment, hexagonal end ball retainer, -02 RPTFE seats rated for 125 PSIG @ 353°F, four bolt actuator mounting configuration to ISO standards, Locking lever handle, API 607, Fourth Edition Fire Safe, ANSI B16.34, ANSI/ASME B16.5, ANSI/ASME B16.10, WW-V-35B. Basis of Design:

Carbon Steel Body:
Milwaukee Model: F91CS150R-02
Conbraco Industries; Apollo Model – 87A-100

2. Globe Valves:

a. Globe Valves 1/8" through 2" Globe valves shall be class 150# SWP, 300# CWP, rising stem, union bonnet, body with integral seat. The body, bonnet, union nut, disc holder, & stem shall be ASTM B62, cast bronze (1/4" through 3/4" disc holder ASTM B16, Brass). PTFE Disc. Hand wheel will be Malleable iron. Packing will be Aramid Fiber & Graphite with a Neoprene Binder for service up to 550°F, MSS SP-80. Basis of Design:

Conbraco Industries; Apollo Series – 122T (Threaded)
Milwaukee Model: 590T (Threaded)
NIBCO T/S 235Y
Other manufacturers: Hammond, Lunkehimer

3. Check Valves:

a. Horizontal Swing- ¼" through 2" Check valves shall be class 125# SWP, 200# CWP, horizontal swing check, body with 5° integral seat. Body, cap, & Disc shall be of ASTM B62, cast bronze. (Disc on ¼" through ¾" ASTM B16) Lever, retaining

ring, & Hinge Pin shall be stainless steel. Plug shall be ASTM B16, MSS SP-80, Type 3. Basis of Design:

Conbraco Industries; Apollo Series 163T
Milwaukee Model: 509 (Threaded)
NIBCO T/S 413Y
Other manufacturers: Hammond, Lunkehimer

b. Spring Loaded “Silent” Lift- 3/8” through 2" Check valves shall be 250# CWP. ASTM B584, cast bronze body with integral seat, Tail Piece, & center guided disc holder, ASTM B104, bronze Spring, Buna disc ring. MSS SP-80 Basis of Design:

Conbraco Industries; Apollo Model – 77F
Milwaukee Model: 548B (Threaded)
NIBCO T480
Other manufacturers: Hammond, Lunkehimer

c. Wafer Body “Silent” Double Disc- 2” through 60” Check valves shall be wafer body, spring loaded, dual disc ANSI Class 150 valves. Monobody of ASTM A216, grade WCB cast carbon steel, The discs shall be constructed of ASTM A351, grade CF8M cast stainless steel and will open to a maximum of 85° to insure disc closure. The valve seat shall be a Buna-N and will be bonded into a machined grove in the body. Bona-N seat rated for operating temperatures from -60°F through + 250°F. The springs, shaft, hinge stop & thrust bushing shall be type 316 Stainless Steel and shall be designed such that the spring leg extends beyond the center of the disc to eliminate body seat wear. Double disc wafer check valves will be manufactured in accordance with API standard 594, ANSI B16.34, API 6A & 6D, and inspected and tested in accordance with API standard 598. The manufacturer will permanently engrave the serial number into the valve body. MSS SP-25, MSS SP-55, and MSS SP-61. Basis of Design:

Gulf Valve Model: MB15-2041-SR
Other manufacturers: Milwaukee, Titan

4. Relief Valves

a. UL listed for fuel oil and capacities, ASME certified and labeled. Maximum working temperature: 450 degrees F. Body: Bronze. Seat: Viton. Stem and Springs: Stainless steel. Threaded ends. Automatic type, direct pressure actuated at maximum 60 psi.

5. BACK PRESSURE REGULATING VALVE

a. Product Description: Iron body, spring housing, threaded ends, Buna-N diaphragm, stainless steel seat disc, ring body and seat, maximum inlet pressure: 250 psig.

6. STRAINERS

a. 2 inch and Smaller: Y pattern, cast iron body, threaded ends, Class 250, 1/16 inch stainless steel perforated screen.

b. 2-1/2 inch and Larger: Y pattern, cast iron body, flanged ends, Class 250, bolted flange cover, with 1/16 inch stainless steel perforated screen.

7. FLEXIBLE CONNECTORS

a. 2 inches and Smaller: Corrugated Type 304 stainless steel inner hose with single layer of Type 304 stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure 200 psig.
b. 2-1/2 inches and Larger: Corrugated Type 304 stainless steel inner hose with single layer of Type 304 stainless steel exterior braiding, minimum 9 inches long with flanged ends; for maximum working pressure 200 psig.

C. Water Service Drains:

1. Piping Hose Bibbs:

a. All valves at low points in piping systems used for drain valve duty shall be provided with brass or bronze valve body with threaded end connections, chromium plated ball, brass stem, RPTFE seats, seals and stuffing box ring, adjustable packing gland, valve handle, and three quarter (3/4) inch hose connection with cap and chain. All valves shall be as manufactured by Apollo, or Milwaukee. Valve model numbers shall be as listed below:
Apollo – 70 LF HC (3/4 x 3/4)
Milwaukee - BA100H (3/4 x 3/4)
NIBCO T/S 585-70-HC

2. Equipment Hose Bibbs:

a. All valves at low points in piping systems used for drain valve duty shall be provided with brass or bronze valve body with threaded end connections, chromium plated ball, brass stem, RPTFE seats, seals and stuffing box ring, adjustable packing gland, valve handle, and three quarter (3/4”) inch hose connection with cap and chain. All valves shall be as manufactured by Apollo, or Milwaukee. Valve model numbers shall be as listed below:

Apollo – 70 LF HC
Milwaukee - BA100H
NIBCO T/S 585-70-HC

2.3 VALVING SPECIALTIES

A. Pressure Reducing Valves:

1. Pressure reducing valves shall be lead free and shall be as manufactured by Watts Regulator, Zurn, Spence, Conbraco Industries; Apollo Valve, or an acceptable comparable product.
2. Domestic Water Systems: Provide Watts Model 115-7, or equivalent 125 pound, cast iron ASTM A126, Class B, fused epoxy coated inside and outside, stainless steel seat, stainless steel stem, suitable for dead-end service.

3. Factory assembled pressure reducing valve (PRV) Station consisting of a Victaulic Style 972 main line PRV with a bypass line PRV. Assembly includes required Schedule 10S, type 304L, stainless steel pipe conforming to ASTM A312, with Victaulic stainless steel fittings, (4) Series 461 butterfly valves for isolation, (2) Style 732 wye pattern strainers with NSF-61 approved coating upstream of the PRV's, joined with Victaulic installation-ready rigid couplings, Style 107N. All components shall be UL classified in accordance with ANSI / NSF-61 for potable water service, and shall be certified to the low lead requirements of NSF-372.

B. Safety Relief Valves:

1. Provide as manufactured by Conbraco Industries; Apollo Valve, Watts Regulator, Spence, or an acceptable comparable product.
2. 125 psig working pressure and 250°F maximum operating temperature; designed, manufactured, tested, and labeled in accordance with the requirements of Section IV of the ASME Boiler and Pressure Vessel Code.
3. Valve body shall be cast-iron.
4. Valve shall have forged copper alloy disc, fully enclosed cadmium plated steel spring with adjustable pressure range and positive shut-off.
5. Factory set valves to relieve at 10 psi above operating pressure.

C. Combined Pressure/Temperature Relief Valves:

1. Provide as manufactured by Conbraco Industries; Apollo Valve, Watts Regulator, Spence, or an acceptable comparable product.
2. Hydronic Systems: diaphragm operated, cast-iron or brass body valve, with low inlet pressure check valve, inlet strainer removable without system shut-down, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory-set at operating pressure and have the capability for field adjustment. Safety relief valve designed, manufactured, tested, and labeled in accordance with the requirements of Section IV of the ASME Boiler and Pressure Vessel Code. Valve body shall be cast-iron, with all wetted internal working parts made of brass and rubber; 125 psig working pressure and 250°F maximum operating temperature. Select valve to suit actual system pressure and Btu capacity. Provide with fast fill feature for filling hydronic system.

D. Domestic Hot Water Return Balancing Valve:

1. Thermostatic balancing:

a. Provide ITT Bell & Gosset Thermostatic Balancing Valve: Model TSB, or acceptable comparable product as manufactured by CircuitSolver.
b. The valve shall be certified lead free according to NSF/ANSI 61 standards.
c. The valve body shall be constructed out of 316 stainless steel.
d. The valve shall be rated for 145 PSIG working pressure.
e. The valve shall have a temperature adjustment dial in GPM. The dial shall have an adjustment range of 98°F to 150°F.
f. The valve shall have a temperature accuracy of ±3.6°F.
g. Temperature dial shall have a built-in magnifying glass cover.
h. The valve shall have a wax thermostatic element that is out of contact with the circulating water.
i. The valve shall include a polystyrene (EPS) thermal insulation block with Velcro straps.

j. The valve shall include a built-in bypass to allow for thermal disinfection of the domestic how water recirculation system.
k. The valve bypass shall have a flow range of 0.06 – 0.29 GPM.
l. The valve bypass shall be manually adjustable with a GPM dial to set the bypass flow rate.
m. The valve bypass dial shall have a built-in magnifying glass cover.
n. Install Thermostatic Balance Valve in accordance with manufacturer's instructions

E. Domestic Water Meter (MTR-1 through MTR-6)

1. Basis-of-Design Product: Subject to compliance with specifications, provide flow measurement technology by Recordall by Badger Meter.
2. Operational Requirements

a. Housing Material
   1) Bronze
b. Meter Size
   1) As indicated on drawings.
c. Flow Range
   1) 3/4 – 35 gpm
d. Maximum Operating Temperature
   1) 250° F

F. Trap Priming Systems:

1. Flush Valve Type:

a. Where applicable, trap primer make-up lines may be connected to the tailpiece of a diaphragm operated flush valve. The tailpiece shall be chrome and consist of a vacuum breaker, compression fitting, chrome make-up line and wall escutcheon.
b. Unit shall be Precision Plumbing Products FVP-1VB or an acceptable comparable product as manufactured by: Sioux Chief or Sloan.

2. Pressure Differential Valve Type:

a. Trap Primers shall be pressure drop activated and be of all brass construction with ½" male NPT inlet and ½" female NPT discharge. Internal components shall consist of a stainless steel debris screen, brass piston and brass discharge jet. Trap primers shall be installed on fresh cold water lines of 1 ½" diameter or less and shall be located where they will be subject to frequent pressure drops of 5 to 10 psi. Working pressure shall be 20 to 80 psi and valves shall be listed to ASSE 1018.
b. Units shall be Precision Plumbing Products P1-500, P2-500, PR-500 or an acceptable comparable product as manufactured by: Jay R. Smith or Souix Chief.
c. Model P1-500 and P1-500 LL P Series primer valves shall be capable of serving up to 4 floor drains, utilizing distribution unit models: DU-4/DU-U.
d. Model P2-500 and P2-500 LL P Series primer valves shall be capable of serving up to 2 floor drains, utilizing distribution units DU-4/DU-U.

3. Trap Priming Station Type (TPS-1):

a. Furnish and install an automatic trap priming system consisting of the following:
b. Trap primer stations shall be factory assembled, pre-piped and shall include a bronze ¾" NPT inlet ball valve, a stainless steel ¾" electronic solenoid valve; a code approved atmospheric vacuum breaker and a type L copper manifold with ½" or 5/8" brass compression fittings. Unit shall include a single point power connection, 120V/60Hz, a 2 amp breaker, a manual override test switch and a timer preset to energize and open the normally closed solenoid for 10 seconds every 24 hours. Unit shall be provided complete in a flush mount 16 gauge steel box with access door or a surface mount NEMA 1 rated box with a screw on cover.
c. Unit shall be Precision Plumbing Products "Prime Time" series (PT/PTS), or an acceptable comparable product as manufactured by: Zurn.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section: "Administrative Requirements": Verification of existing conditions before starting work.

B. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.

C. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

D. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.

E. Examine threads on valve and mating pipe for form and cleanliness.

F. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

G. Examine grooved ends for form and cleanliness. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from valve/pipe end to groove.

H. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION OF VALVES

A. Valves shall be placed in such manner as to be easily accessible for smooth and easy handwheel operation and packing maintenance.

B. Install valves in piping where shown and where listed herein:

1. To balance flows in water piping systems.
2. To isolate all items of equipment.

3. To isolate branch lines and risers at mains.
4. To drain low points in piping systems.
5. To drain pipe risers.
6. To drain equipment.

C. Where piping or equipment may be subsequently removed, provide valves with bodies having integral flanges or full lugs drilled and tapped to hold valve in place so that downstream piping or equipment can be disconnected and replaced with blank-off plate while valve is still in service.

D. Valves for equipment and controls shall be installed full size of pipe before reducing size to make equipment connection.

E. Where there is not interference, gate and globe shut-off valves shall be installed with handwheel up on horizontal runs of pipe to prevent accumulation of foreign matter in working parts of valves. In no case shall the stem be installed below the pipe centerline.

F. Butterfly valves shall be installed with handle position in the horizontal position: i.e., butterfly pivot point parallel with the floor.

G. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.

H. Install valves in a position to allow full handle movement.

I. For chain-wheel operators, provide chains to 60 inches above finished floor elevation.

J. Installation of Check Valves: Install for proper direction of flow as follows:

1. Swing Check Valves: Horizontal position with hinge pin level.
2. Lift Check Valve: With stem upright and plumb.
3. Install check valves on each pump discharge and elsewhere as required to control flow direction.

K. Install drain valves at low points in mains, risers, branch lines, and everywhere else required to permit drainage of the entire system.

L. Install pump discharge valves with stem in upward position.

M. Install safety relief valves on hot water generators, pressure vessels, etc. and elsewhere as required by ASME Boiler and Pressure Vessel Code. Pipe discharge without valves as shown on drawings or to nearest floor drain if not shown on drawings. Comply with ASME Boiler and Pressure Vessel Code Section VIII, Division 1 for installation requirements.

N. Provide balancing valves as shown on drawings and as required to permit complete balancing of all systems.

O. Provide access where valves and fittings are not accessible.

P. Install spring loaded check valves on discharge of water pumps.

Q. Install lug end butterfly valves adjacent to equipment when functioning to isolate equipment.

3.3 INSTALLATION OF THREADED CONNECTIONS

A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.

B. Align threads at point of assembly.

C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.

D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.4 INSTALLATION OF FLANGED CONNECTIONS

A. Align flange surfaces parallel.

B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.5 INSTALLATION OF VALVING SPECIALTIES SPECIFIC TO WATER SYSTEMS

A. Install pump discharge valves in horizontal or vertical position with stem in upward position. Allow clearance above stem for check mechanism removal.

B. Install pressure-regulating and reducing valves with inlet and outlet shutoff valves and balance valve bypass. Install pressure gage on valve outlet and install valved bypass where indicated. Install unions at inlet and outlet connections.

C. Install hose bibbs with integral or field-installed vacuum breaker.

D. Install trap seal primer valves with valve outlet piping pitched down toward drain trap a minimum of 1/8” inch per foot (1 percent) and connect to floor drain body, trap, or inlet fitting. Adjust valve for proper flow.

E. Adjusting

1. Adjust operation and correct deficiencies discovered during commissioning.

    a. Electrical Connections: Power wiring and disconnect switches are specified in Division 26
    b. Grounding & Bonding for Electrical Systems: Connect unit components to ground according to the National Electrical Code and Specification Section “Grounding.”

3.6 ADJUSTING VALVES

A. VALVES: Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including the General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other Sections of Division 22.

1.2 SUMMARY

A. General Requirements:

1. Incorporate in construction pipe hangers and supports to manufacturer's recommendations utilizing manufacturer's regular production components, parts, and assemblies.
2. Comply with maximum load ratings with consideration for allowable stresses prescribed by ASME B31.1 or MSS SP-58.
3. Provide support, guides and anchors that do not transmit unacceptable heat and vibration to building structure.
4. Installation of pipe hangers and supports shall be based upon the overall design concept of the piping system. The support system shall provide for an control the free movement of piping including its movement in relation to that connected equipment.
5. Provide for vertical adjustments after installation of supported material and during commissioning, where feasible, to ensure pipe is at design elevation and slope.

B. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Acoustical Sealant
6. Mechanical sleeve seals.
7. Formed steel channel.
8. Firestopping relating to plumbing work.
9. Firestopping accessories.
10. Equipment bases and supports.
11. Non-penetrating rooftop pipe hangers and supports.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 03 Section: "Concrete Forming and Accessories": Execution requirements for placement of inserts in concrete forms specified by this section.
2. Division 03 Section: "Cast-In-Place Concrete" : Execution requirements for placement of concrete housekeeping pads specified by this section.

3. Division 07 Section: “Firestopping” : Product requirements for firestopping for placement by this section.
4. Division 07 Section: “Joint Protection”: Product requirements for sealant materials for placement by this section.
5. Division 09 Section: “Painting and Coating”: Product and execution requirements for painting specified by this section.
6. Division 22 Section: “Common Work Results for Plumbing”.
7. Division 22 Section: “Plumbing Insulation”.
8. Division 22 Section: “Pipes and Tubes for Plumbing Piping and Equipment”: Execution requirements for placement of hangers and supports specified by this section.
9. Division 22 Section: “Vibration and Seismic Controls for Plumbing Piping and Equipment”: Product and execution requirements for vibration isolators.

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”)

A. American Society of Mechanical Engineers:

1. ASME B31.1 - Power Piping.
2. ASME B31.5 - Refrigeration Piping.
3. ASME B31.9 - Building Services Piping.

B. ASTM International:

1. Structural Steel: ASTM A 36/A 36M, “Carbon Structural Steel,” steel plates, shapes, and bars, black and galvanized.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, “Track Bolts and Nuts,” steel, hex-head, track bolts and nuts.
3. Grout: ASTM C 1107, Grade B, “Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink),” non-shrink, nonmetallic.
4. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
5. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
6. ASTM F708 - Standard Practice for Design and Installation of Rigid Hangers.
7. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
8. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
9. Washers: ASTM F 844, “Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use,” steel, plain, flat washers.

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

D. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports – C Selection and Application.

3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
4. MSS SP 90 – Valves and Fittings Standards.

F. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

G. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.4 DEFINITIONS

(Unless otherwise noted, references apply to "latest editions.")

A. Terminology used in this Section is defined in Manufacturer's Standardization Society Specification - 90, Valve and Fittings Standards.

B. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.5 SUBMITTALS

A. Division 01 Section: "Submittal Procedures": Submittal procedures.

B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.

C. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers. Submit sizing methods sealed by a registered professional engineer.

F. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

H. Firestopping Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

I. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

J. Submission of samples may be requested for each type of hanger device. After approval, samples shall be returned for installation at job site.

K. Comply with VOC limitations under section 099100.

L. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.6 QUALITY ASSURANCE

(Unless otherwise noted, references apply to “latest editions.”)

A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code – Steel.”

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

C. NFPA Compliance: Comply with NFPA 13, “Installation of Sprinkler Systems,” for hangers and supports used as components of fire protection systems.

D. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70 “Definitions.”

1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.

E. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.

F. Supply and install incidental materials needed to meet requirements, even if not expressly specified or shown on drawings without claim for additional payment.

G. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

H. Should any rotating equipment cause excessive noise or vibration, rebalance, realign or do other remedial work to reduce noise and vibration levels. Excessive is defined as exceeding manufacturer's specifications for unit in question.

I. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

a. Floor Penetrations Within Wall Cavities: T-Rating is not required.

J. Through Penetration Firestopping of Non-Fire Rated Floor and Roof assemblies: Materials to resist free passage of flame and products of combustion.

1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

K. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.

L. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

M. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

N. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with a minimum of five years documented experience.

1.8 PRE-INSTALLATION MEETINGS

A. Division 01 Section: “Administrative Requirements”: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with Division 01 Section: “Product Requirements” for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section: “Product Requirements”: Environmental conditions affecting products on site.

B. Do not apply firestopping materials when temperature of substrate material and ambient air is not in accordance with the manufacturer’s installation procedures.

C. Maintain manufacturer’s required temperature before, during, and after installation of firestopping materials for minimum periods of time as required by the manufacturer.

D. Provide ventilation in areas to receive solvent cured materials.

1.11 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.12 WARRANTY

A. Division 01 Section: “Execution and Closeout Requirements”: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for pipe hangers and supports.

PART 2 - PRODUCTS

(Unless otherwise noted, references apply to “latest editions.”)

2.1 MATERIALS

A. Structural Steel: ASTM A 36, “Carbon Structural Steel,” steel plates, shapes, and bars, black and galvanized.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, “Track Bolts and Nuts,” steel, hex-head, track bolts and nuts.

C. Washers: ASTM F 844, “Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use,” steel, plain, flat washers.

D. Grout: ASTM C 1107, Grade B, “Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink),” non-shrink, nonmetallic.

1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is non-staining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Water: Potable.
4. Packaging: Premixed and factory-packaged.

2.2 PIPE HANGERS AND SUPPORTS

A. Hangers, Supports, and Components: Provide factory-fabricated products as manufactured by B-Line, AITT Grinnel, Pipe Shields, Inc., or Erico CADDY. Basis of Design shall be B-Line.

1. Components include galvanized coatings where installed for piping and equipment that will not have a field-applied finish.
2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

B. Upper attachments to structures shall have an allowable load not exceeding 3 of the failure (proof test) load but are not limited to the specific methods indicated.

C. Horizontal Non-Insulated Waste, Vent and Storm Water Piping Hangers:

1. Two inch and smaller: Figure No. B3170.
2. Two and one-half inch and larger: Figure No. B3100.

D. Horizontal Non-Insulated Copper Piping Hangers:

1. Two inches and smaller: Figure No. B3104 CTC.
2. Two and one-half inch and larger: Figure No. B3104 CT.

E. Insulated Horizontal Piping hangers; Cold and Hot Water (Domestic)

1. Two inches and smaller: Figure No. B3108 with metal shield, Figure No. B3151.
2. Two and one-half inches and larger: Figure No. B3108 with metal shield, Figure No. B3151.

F. Vertical Piping Riser Clamps:

1. Copper Pipe: Figure No. B3373CT.
2. Steel Pipe: Figure No. B3136 and B3137.

G. PVC, and CPVC Piping:

1. Figure No. B3106 with No. B3106V channel, plastic-coated.
2. For piping 1 inch and smaller, use continuous support system only.

H. Beam Clamps and Attachments:

1. For bolt-on locations to structure, Figure Nos. B3291, B3036, or B3050.
2. Welded beam attachments, Figure No. B3083.

I. Brackets:

1. For equipment and piping adjacent to walls or steel columns, Figure Nos. B3066, B3063 and B3067 depending on weight to be supported.

J. Pipe Rests:

1. For pipes close to floor where no expansion provision is required, Figure No. B3088T base stand with B3093 adjustable pipe saddle support.

K. Hanger Rods:

1. Hanger rod, Figure No. B3205.
2. Continuous threaded rod, Figure No. ATR.
3. Eye rods, Figure No. B3210 or B3211, depending on load supported.

L. Trapeze Hangers - Direct Mounting Hangers:

1. Grinnell, Figure No. 46.

M. Protection Saddles:

1. Cast iron pipe, insulated, Figure No. B3108 with metal shield, Figure No. B3151.
2. For high temperature steel pipe, insulated, No. B3160, B3161, B3162, B3163, B3164, or B3165.

N. Pipe Roll Stands:

1. For support of pipe where axial movement is encountered: Figure No. B3117SL where no vertical adjustment is required; and Figure No. B3118SL where vertical adjustment is required.

O. Horizontal AWWA Piping (Flanged or Bell-spigot) Hangers:

1. Cast iron pipe, Figure No. B3102.

2.3 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.4 INSERTS

A. Hangers, Supports, and Components: Provide factory-fabricated products as manufactured by B-Line, AITT Grinnel, Pipe Shields, Inc., or Erico CADDY. Basis of Design shall be B-Line.

B. Thermal-Hanger Shield Inserts: 100-psi average compressive strength, waterproofed calcium silicate or treated lumber inserts, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.

C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

E. Concrete Inserts:

1. For concrete spot inserts at single locations for casting into structure, Figure No. B3014 for pre- determined rod size and Figure No. B2500 for universal use.
2. For continuous slot concrete insert at multi-locations for casting into structure, Figure No. B2505.

F. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.5 FLASHING

A. Metal Flashing: 26 gage thick galvanized steel.

B. Metal Counterflashing: 22 gage thick galvanized steel.

C. Lead Flashing:

1. Waterproofing: 5 lb./sq. ft sheet lead.
2. Soundproofing: 1 lb./sq. ft sheet lead.

D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.6 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sealant: Acrylic.

2.7 MECHANICAL SLEEVE SEALS

A. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.8 FORMED STEEL CHANNEL

A. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.9 FIRESTOPPING

A. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Single component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

2.10 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:

1. Mineral fiberboard.
2. Mineral fiber matting.
3. Sheet metal.
4. Plywood or particle board.
5. Alumina silicate fire board.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:

1. Furnish UL listed products.Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

2.11 ACOUSTICAL SEALANT

A. Sealants for acoustical purposes shall be one of following non-setting sealants:

Acoustical sealant .....D.A.P.

BR – 96 .....Pecra

Acoustical sealant.....Tremco

Acoustical sealant .....U.S.G.

2.12 NON-PENETRATING ROOFTOP PIPE HANGERS AND SUPPORTS

A. Supports, hangers, accessories, walk pads, etc… shall be as manufactured by Miro Industries, comparable products as manufactured by PHP Systems design or Advanced Support products OR Erico CADDY may be submitted for review as comparable products.

B. Provide with bases that rest upon walk pads. Bases shall have rounded edges to prevent damage to the roof, carbon black additive in polycarbonate for UV stabilization, and stainless steel all threads for adjustability.

C. Plumbing and gas piping shall be supported by rollers, similar to Miro Industries Model 4-RAH series or Erico CADDY PYRAMID RL series.

D. Condensate lines shall be supported by strut, similar to Miro Industries Model 2.5 CS-5” or Erico CADDY PYRAMID EZ series.

E. The walk pads shall be supplied by the roofing manufacturer, or prefabricated non-penetrating piping system manufacturer’s support pads are acceptable.

F. Accessories:

1. Support Pads: pads shall be 15-3/4 by 19-3/4 inch square, 1/8 inch thick, flexible PVC with carbon black additive for UV stabilization.
2. Deck Plates: Provide square metal deck plates with curved up edges, to spread load and protect roof membrane, sizes and quantities of Deck Plates shall be per prefabricated non-penetrating piping system manufacturer’s recommendations.
3. Rollers:

    a. Provide pipe rollers in sizes and quantities as recommended by manufacturer.

2.13 NO-HUB FITTING RESTRAINTS

A. Provide Holdrite model #117-LL or approved comparable product series no-hub fitting restraints in accordance with the installation instruction of US cast iron soil pipe manufacturers. CISPI designation 310-11 and the 20006 CISPI installation handbook. The system shall restrain (2) 45 degree 1/8 bend onto the adjoining pipe. The system shall be stainless steel bands that meet a torque of 60 in/lbs minimum. The restraint system shall meet a thrust pressure rating equal to 50 feet of head of water pressure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section: “Administrative Requirements”: Verification of existing conditions before starting work.

B. Verify openings are ready to receive sleeves.

C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Install damming materials to arrest liquid material leakage.

C. Remove incompatible materials affecting bond.

D. Drilling or cutting of structural members shall be as detailed / directed by structural engineer.

3.3 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

(Unless otherwise noted, references apply to “latest editions.”)

A. General

1. Comply with MSS SP-69 and SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. Piping shall be supported independently from equipment connections. Supports shall not interfere with removal of equipment.
2. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.
3. Install supports with maximum spacings complying with MSS SP-69.

4. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
5. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69,"Pipe Hangers and Supports C Selection and Application." Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts in new construction prior to placing concrete. Install reinforcing bars through openings at top of inserts.
6. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.
7. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.
8. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
9. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
10. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
11. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
12. Place hangers within 12 inches of each horizontal elbow.
13. Use hangers with 1-1/2 inch minimum vertical adjustment.
14. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
15. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
16. Support riser piping independently of connected horizontal piping.
17. Provide copper plated hangers and supports for copper piping.
18. Design hangers for pipe movement without disengagement of supported pipe.
19. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
20. Provide clearance in hangers and from structure and other equipment for installation of insulation.
21. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
22. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9, is not exceeded.
23. Insulated Piping: Provide continuous insulation and vapor barrier through hangers and supports. Comply with the following installation requirements.
24. Riser Clamps: Attach riser clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9. Insulate clamps on piping with insulation and vapor barrier.
25. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
26. Shields: Install MSS Type 40, protective shields on cold piping with vapor barrier. Shields span an arc of 180 degrees and have dimensions in inches not less than the following:

NPS (Inches)	LENGTH (Inches)	THICKNESS (Inches)
1/4 to 3 1/2	12	0.048
4	12	0.060
5 and 6	18	0.060

27. Pipes 4 Inches and Larger: Include treated wood inserts.
28. Insert Material: Length to equal to the length of the protective shield.
29. Conform to the table below for maximum spacing of supports and rod sizes:

a. Steel and Copper Pipe:

Nom. Pipe Size – In.	Steel Pipe Max. Span – Ft.	Copper Tube Max. Span – Ft.	Min. Rod Dia. – In.
Up to 3/4	7	5	3/8
1	7	6	3/8
1 1/4	7	7	3/8
1 1/2	9	8	3/8
2	10	8	3/8
2 1/2	11	9	1/2
3	12	10	1/2
3 1/2	13	11	1/2
4	14	12	5/8 (1/2 for copper)
5	16	13	5/8 (1/2 for copper)
6	17	14	3/4 (5/8 for copper)

30. Drain Piping:

Pipe Material	Horizontal In Feet	Vertical In Feet
Cast-Iron Soil Pipe	5	15
CPVC Plastic Pipe	3	3
PVC Plastic Pipe	4	4

a. Support plastic pipe and tubing in accordance with manufacturer's recommendations.
b. Support cast-iron piping at each hub.

31. Equipment Supports:

a. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
b. Grouting: Place grout under supports for equipment and concrete bases. Make a smooth bearing surface.

3.5 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.

B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:

D. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

E. Obtain fusion without undercut or overlap.

F. Remove welding flux immediately.

G. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.6 PAINTING

A. Touching Up: Clean field welds and abraded areas of factory paint and paint exposed areas immediately after erection of hangers and supports. Use same materials as used for factory painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

B. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

C. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of factory paint on miscellaneous metal is specified in Division 09 Section ”Painting and Coating”.

D. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.7 APPLICATIONS FOR HANGER AND SUPPORT

A. Specific hanger requirements are specified in the Section specifying the equipment and systems.

B. Comply with MSS SP-69, for pipe hanger selections and applications that are not specified in piping specification Sections.

3.8 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 3 ½" thick and extending 6" beyond supported equipment.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Division 22 Section: "Vibration and Seismic Controls for Plumbing and Equipment."

3.9 INSTALLATION - FLASHING

A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.

C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.

D. Seal floor drains and floor sinks watertight to adjacent materials.

E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.10 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 2 inches above finished floor level. Caulk sleeves.

E. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

F. Install stainless steel escutcheons at finished surfaces.

3.11 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating to uniform density and texture.

D. Compress fibered material to maximum 40 percent of its uncompressed size.

E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

F. Place intumescent coating in sufficient coats to achieve rating required.

G. Remove dam material after firestopping material has cured.

H. Fire Rated Surface:

1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
2. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
3. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
4. Pack void with backing material.
5. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
6. Where pipe, duct, conduit, etc. penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

I. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall, partition, floor, ceiling, and roof opening as follows:
2. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
3. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
4. Install type of firestopping material recommended by manufacturer.
5. Install escutcheons floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
6. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
7. Interior partitions: Seal pipe penetrations at all rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.12 FIELD QUALITY CONTROL

A. Division 01 Section: “Quality Requirements”: Requirements for inspecting, testing.

B. Inspect installed firestopping for compliance with specifications and submitted schedule.

C. Licensed Engineer's Report: Prepare hanger and support installation report. Include seal and signature of Registered Engineer, licensed in jurisdiction where Project is located, certifying compliance with specifications.

3.13 CLEANING

A. Division 01 Section: “Execution and Closeout Requirements”: Requirements for cleaning.

B. Clean adjacent surfaces of firestopping materials.

3.14 PROTECTION OF FINISHED WORK

A. Division 01 Section: “Execution and Closeout Requirements”: Requirements for protecting finished work.

B. Protect adjacent surfaces from damage by material installation.

3.15 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Adjust for pipe alignment and final equipment connections. Flexible connections shall not be used for adjustment of alignment.

3.16 NON-PENETRATING ROOFTOP PIPE HANGERS AND SUPPORTS

A. Determine that roof structure, roof insulation, and roof membrane are structurally adequate to support weight of pipe, duct, conduit, and supports and hangers.

B. Install supports and hangers in accordance with non-penetrating roof pipe support manufacturer’s recommendations.

C. Install supports at maximum spacing of 10’, unless closer spacing is required due to weight of pipe. Do not exceed non-penetrating manufacturer’s recommended load limits.

D. Support Pads: Remove rock from area to be covered by pad, apply pad on cleaned area, and center bases on top of support pads.

E. Set pipe in support without dropping or causing undue impact.

3.17 NO-HUB FITTING RESTRAINTS

A. A. Shall be installed at the base on all drainage risers.

END OF SECTION

SECTION 22 05 48
VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including the General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other Sections of Division 22

1.2 SUMMARY

A. This Section includes vibration, wind, and seismic control for plumbing systems piping and equipment. It is the intent of the seismic portion of this specification to keep all plumbing building system components in place during a seismic event.

B. The requirements for seismic protection measures to be applied to mechanical equipment and systems specified herein are in addition to any other items called for in other Sections of the Specifications. Provide seismic bracing for equipment and systems within the project area. Seismic forces shall be calculated by a qualified Licensed Professional Engineer. Seismic bracing and anchors shall be designed by the Licensed Professional Engineer to withstand the calculated seismic forces per the specified project conditions.

C. All components mounted outside of the building envelope (on-grade, on roof, on exterior walls, etc.) shall be mounted and supported to resist wind loads as required by the International Building Code (IBC), edition in effect by local authority having jurisdiction. Wind forces shall be calculated by a qualified licensed Professional Engineer to withstand the calculated wind forces per the specified project conditions.

D. Section includes:

1. Materials.
2. Seismic controls.
3. Vibration Isolation Mount types.
4. Equipment bases.
5. Resilient Penetration sleeve/seal.
6. Seismic snubber.
7. Flexible electrical connections.
8. Restraints.
9. Gromments.
10. Acoustical sealant.
11. Vibration isolation schedule.

E. Related Sections: The following sections contain requirements that relate to this section:

1. Division 03 Section: “Cast-in-Place Concrete”: Product requirements for concrete for placement by this section.
2. Division 07 Section: “Joint Protection”: Product requirements for joint sealers specified for placement by this section.

3. Division 22 Section: “Common Work Results for Plumbing.”
4. Division 22 Section: “Pipes and Tubes for Plumbing Piping and Equipment.”
5. Division 22 Section: “Expansion Fittings and Loops for Plumbing Piping”: Product requirements for anchors and piping expansion compensation.
6. Division 22 Section: “Hangers and Supports for Plumbing Piping and Equipment”: Product requirements for pipe hangers and supports.
7. Division 23 Section: “Testing, Adjusting, and Balancing for HVAC”: requirements for sound and vibration measurements performed independent of this section.

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”) (FOR SEISMIC AND WIND ONLY- references apply to the edition adopted and / or referenced by the building code applicable to the project).

A. American National Standards Institute:

1. ANSI S1.4 - Sound Level Meters.
2. ANSI S1.8 - Reference Quantities for Acoustical Levels.
3. ANSI S12.36 - Survey Methods for the Determination of Sound Power Levels of Noise Sources.

B. Air-Conditioning and Refrigeration Institute:

1. ARI 575 - Method of Measuring Machinery Sound within Equipment Space.

C. American Society of Heating, Refrigerating and:

1. ASHRAE Handbook - HVAC Applications. Manufacturer’s Standardization Society of the Valves and Fittings Industry:

D. American Welding Society:

1. AWS D1.1 – Structural Welding Code – Steel.

E. American Society of Mechanical Engineers:

1. ASME B18.10 or ASTM A183, Track Bolts, and Nuts. Steel, Hex Head, Track Bolts and Nuts

1.4 DEFINITIONS

A. Terminology used in this Section is defined in Manufacturer’s Standardization Society Specification 90, “Valve and Fittings Standards,” “latest edition”.

B. Life Safety Systems:

1. All systems involved with fire protection including sprinkler piping, and service water supply piping systems.

2. All plumbing systems involved with and/or connected to emergency power supply including all generators, transfer switches, transformers and all flowpaths to fire protection.

C. Positive Attachment:

1. A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided “C” type beam clamps for support rods of overhead piping, fire protection, or any other equipment are not acceptable on this project as seismic attachment points.

D. Transverse Bracing:

1. Restraint(s) applied to limit motion perpendicular to the centerline of the pipe.

E. Longitudinal Bracing:

1. Restraint(s) applied to limit motion parallel to the centerline of the pipe, duct or conduit.

1.5 PERFORMANCE REQUIREMENTS

A. Provide vibration isolation on motor driven equipment over 0.5 hp, plus connected piping.

1.6 SUBMITTALS

A. Division 01 Section: “Submittal Procedures”: Submittal Procedures.

B. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating, materials and dimensional data.

C. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.

D. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions.

E. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.

F. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

G. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

H. Shop drawings for each type of isolator, indicating dimensions, weights, required clearances, and methods of component assembly.

I. Submit following in accordance with Conditions of Contract and Division 1 Specifications:

1. Shop drawings of items.

2. Complete description of products to be supplied including product data, dimensions materials of construction and specifications.
3. Installation instructions for each product.
4. Tabulation showing for each vibration isolator supporting equipment:

    a. Equipment identification tag no.
    b. Isolator type.
    c. Actual load.
    d. Static deflection expected under actual load.
    e. Specified minimum static deflection.
    f. Additional deflection to solid under actual load.
    g. Ratio of spring height under actual load to spring diameter.

5. Layout of piping to be isolated including vertical risers showing:

    a. Support points.
    b. Weight at support points.
    c. Isolator type.
    d. Static deflection expected under actual load.
    e. Specified static deflection.
    f. Additional deflection to solid under actual load.
    g. Ratio of spring height under load to spring diameter.

6. Steel rails, steel base frames, and concrete inertia bases showing all steel work, reinforcing, vibration isolator mounting attachment method and location of equipment attachment bolts.
7. Special details at large scale and other necessary information to convey understanding of work.

J. Seismic Certification and Analysis:

1. Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.
2. All restraining devices shall be tested or calculated showing maximum restraint ratings. Preapprovals based on independent testing are preferred to preapprovals based on calculations. Where preapproved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of the job location. Testing and calculations must include both shear and tensile loads as well as one test or analysis at 45E to the weakest mode.
3. Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in section 1.5 acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

K. Submission of samples may be requested for each type of vibration isolation device. After approval, samples shall be returned for installation at job site.

L. Comply with VOC limitations under section 099100.

M. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with ARI 575.

B. Qualify welding processes and welding operators according to AWS D1.1 “Structural Welding Code – Steel”, “latest edition”.

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

D. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:

1. Determine vibration isolation and seismic restraint sizes and locations.
2. Provide calculations and materials if required for restraint of un-insulated equipment.
3. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.

E. Licensed Operators: Use operators that are licensed by power operated tool manufacturers to operate their tools and fasteners.

F. Coordinate size, location, and special requirements of vibration isolation equipment and systems with other trades. Coordinate plan dimensions with size of housekeeping pads.

G. Provide vibration isolators of appropriate sizes and proper loading to meet specified deflection requirements.

H. Supply and install incidental materials needed to meet requirements, even if not expressly specified or shown on drawings without claim for additional payment.

I. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

J. Should any rotating equipment cause excessive noise or vibration, rebalance, realign or do other remedial work to reduce noise and vibration levels. Excessive is defined as exceeding manufacturer's specifications for unit in question.

K. Speed And Balance Requirements For Rotating Equipment:

1. Fans and other rotating mechanical equipment shall not operate at speeds in excess of 80% of their critical speed.
2. Vertical vibration of rotating equipment shall not be greater than levels indicated elsewhere. Measure vibration on equipment or steel frame equipment base when equipment is mounted on its vibration isolation mounts. If equipment has inertia base, allowable vibration level is reduced by ratio of equipment weight alone to equipment weight plus inertia base weight.

Equipment Speed (RPM)	Vibration Displacement (mils, peak-to-peak)
Under 600	4
600 to 1000	3
1000 to 2000	2
Over 2000	1

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.10 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.11 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

B. Indicate field measurements on shop drawings.

1.12 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for inertia bases.

PART 2 - PRODUCTS

2.1 INTENT

A. All vibration isolators and seismic/wind restraints described in this Section shall be the product of a single manufacturer. Acceptable manufacturers include: Vibro-Acoustics, Kinetics Noise Control, Mason Industries or a comparable acceptable manufacturer who is an active member of the Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).

2.2 MATERIALS

A. Structural Steel: ASTM A 36/A 36M, “Carbon Structural Steel,” “latest edition”, steel plates, shapes, and bars, black and galvanized.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, “Track Bolts and Nuts,” “latest edition”, steel, hex-head, track bolts and nuts.

C. Washers: ASTM F 844, “Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use,” steel, plain, flat washers.

D. Grout: ASTM C 1107, Grade B, “Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink),” non-shrink, nonmetallic.

1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is non-staining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.
2. Design Mix: 5000-psi (34.5MPa), 28-day compressive strength.
3. Water: Potable.
4. Packaging: Premixed and factory-packaged.

2.3 SEISMIC RESTRAINT

A. Insulated Horizontal Piping Hangers:

1. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cables must be rated to achieve a certified minimum modulus of elasticity. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize clamping mechanisms to provide proper cable engagement. Cables must not be allowed to bend across sharp edges. Seismic cable assemblies are the preferred method of restraint where applicable. Cable assemblies shall be model BB/BBR as manufactured by Vibro-Acoustics, Model KSCU, KSWC, and/or KSCC as manufactured by Kinetics

Noise Control, or type SCB, SCBH or SCBV as manufactured by Mason Industries, Inc., or comparable acceptable product.

2. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of 2 and arranged to provide all directional restraint. Seismic solid brace end connectors shall be steel assemblies that swivel to the final installation angle and utilize two through bolts to provide proper attachment. Solid seismic brace assemblies shall be manufactured and supplied by Vibro-Acoustics type RRK, Kinetics Noise Control or type SSB, SSBS or SSRF as manufactured by Mason Industries, Inc., or comparable acceptable product.

   a. Steel angles, sized to prevent buckling, shall be clamped to duct or equipment rods utilizing ductile iron clamps at each restraint location when required after seismic force analysis completed by restraint supplier and/or restraint manufacturer's engineers. Welding of support rods is not acceptable. Hanger rod stiffener kits shall be Model VAC as manufactured by Vibro-Acoustics, Model KHRC-B and/or KHRC-C as manufactured by Kinetics Noise Control or type SRC or UC as manufactured by Mason Industries, Inc., or comparable acceptable product.

   b. Pipe clevis cross bolt braces are required in all solid brace type restraint locations. They shall be special purpose preformed channels deep enough to be held in place by bolts passing over the cross bolt. Clevis hanger brace kit shall be Model KCHB as manufactured by Kinetics Noise Control or type CCB as manufactured by Mason Industries, Inc., or comparable acceptable product.

B. Vertical Piping Riser Seismic Restraints:

1. All-directional acoustical pipe anchor, consisting of cable restraint assemblies or two sizes of steel tubing separated by a minimum 1/2" thick 60 durometer neoprene. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material should not exceed 500 psi and the design shall be balanced for equal resistance in any direction. All-directional anchors shall be Model KPA as manufactured by Kinetics Noise Control or type ADA as manufactured by Mason Industries, Inc., or comparable acceptable product.

2. Pipe guides shall consist of spring assemblies or a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2" thickness of 60 durometer neoprene. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of 1 5/8" motion, or to meet location requirements. Pipe guides shall be Model KPG as manufactured by Kinetics Noise Control or type VSG as manufactured by Mason Industries, Inc., or comparable acceptable product.

2.4 RESILIENT PENETRATION SLEEVE/SEAL

A. Unit RPS-A (Resilient Penetration Sleeve/Seal)

1. The horizontal thrust restraint shall consist of a spring element in series with a neoprene molded cup as described in specification 5 with the same deflection as specified for the mountings or hangers. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4" movement at start

and stop. The assembly shall be furnished with 1 rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit. Horizontal thrust restraints shall be type WBI/WBD as manufactured by Mason Industries, Inc., or comparable acceptable product.

2.5 SEISMIC SNUBBER

A. For equipment base: All-directional seismic snubbers shall consist of interlocking steel members restrained by a one-piece molded neoprene bushing of bridge bearing neoprene. Bushing shall be replaceable and a minimum of 1/4" thick. Rated loadings shall not exceed 1000 psi. A minimum air gap of 1/8" shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Neoprene bushings shall be rotated to insure no short circuits exist before systems are activated. Snubber shall be type SS as manufactured by Vibro-Acoustics, Model HS-5 as manufactured by Kinetics Noise Control or type Z-1225 as manufactured by Mason Industries, Inc., or comparable acceptable product.

B. For equipment direct connection: All directional seismic snubbers shall consist of interlocking steel members restrained by shock absorbent rubber materials compounded to bridge bearing specifications. Elastomeric materials shall be replaceable and a minimum of 3/4" thick. Rated loadings shall not exceed 1000 psi. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8" (3mm) no more than 1/4". Snubbers shall be installed with factory set clearances. The capacity of the seismic snubber at 3/8" deflection shall be equal or greater than the load assigned to the mounting grouping controlled by the snubber multiplied by the applicable “G” force. Submittals shall include the load deflection curves up to 1/2" deflection in the x, y and z planes. Snubbers shall be type SRB as manufactured by Vibro-Acoustics, Model HS-5 as manufactured by Kinetics Noise Control or Type Z-1011 as manufactured by Mason Industries, Inc., or comparable acceptable product.

2.6 FLEXIBLE ELECTRICAL CONNECTION

A. Unit FEC-A (Flexible Electrical Connection Type A):

1. Flexible electrical coupling shall be prefabricated units incorporating flexible watertight outer jacket, grounding strap, plastic inner sleeve to maintain smooth wire way and end hubs with standard tapered electrical threads to fit standard threaded, rigid metal conduit.
2. Unit FEC-A shall be as specified in section “Raceways and Boxes for Electrical Systems” for liquid tight flexible metal conduit.

B. Unit FEC-B (Flexible Electrical Connection Type B):

1. Flexible electrical couplings shall be field-fabricated using minimum 2 ft length of flexible conduit or cable installed in grossly slack "U" shape.
2. Unite FEC-B shall be as specified in section “Raceways and Boxes for Electrical Systems” for flexible metal conduit.

2.7 RESTRAINTS

A. Thrust Restraint

1. Thrust restraints shall consist of spring element in series with Neoprene pad.
2. Thrust restraint shall be designed to have same deflection as specified for isolators supporting equipment generating thrust.
3. Spring element shall be contained within steel frame and be designed to be factory-preset for thrust and be field-adjustable to allow for maximum of 1/4" movement during starting or stopping of equipment.
4. Furnish assembly complete with rods and angle brackets for attachment to both equipment generating thrust and adjacent fixed structural anchor.
5. Thrust restraint shall be type AHCS or HCS as manufactured by Vibro-Acoustics, Model HSR as manufactured by Kinetics Noise Control or Mason Industries Type WB, or comparable acceptable product.

2.8 GROMMETS

A. Grommets shall be one piece molded bridge-bearing neoprene washer/bushing type. The bushing shall surround the anchor bolt and have a flat washer force to avoid all contact between bolt and base plate. Grommets shall be type GW as manufactured by Vibro-Acoustics, model HG as manufactured by Mason Industries or comparable acceptable product.

B. Neoprene shall be between 40 and 50 durometer.

C. Grommets shall be specially formed to prevent fastening bolts from directly contacting isolator base plate.

2.9 ACOUSTICAL SEALANT

A. Sealants for acoustical purposes shall be one of following non-setting sealants:

1. Acoustical sealant ..... D.A.P.
2. BR-96 ..... Pecra
3. Acoustical sealant ..... Tremco
4. Acoustical sealant ..... U.S.G.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Verify equipment and piping is installed before work in this section is started.

3.2 INSTALLATION

A. Install isolation for motor driven equipment.

B. Bases:

1. Set steel bases for 1 inch clearance between housekeeping pad and base.

2. Set concrete inertia bases for 2 inch clearance between housekeeping pad and base.

C. Adjust equipment level.

D. Install spring hangers without binding.

E. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

F. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

G. Provide resiliently mounted equipment and piping with seismic snubbers. Provide each inertia base with minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 0.05 inch maximum clearance. Provide other snubbers with clearance between 0.15 inch and 0.25 inch.

H. Support piping connections to isolated equipment resiliently to nearest flexible pipe connector as follows:

1. Up to 4 inch Diameter: First three points of support.
2. 5 to 8 inch Diameter: First four points of support.
3. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

3.3 FIELD QUALITY CONTROL

A. Division 01 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect isolated equipment after installation and submit report. Include static deflections.

3.4 INSTALLATION OF SEISMIC HANGERS AND SUPPORTS

A. General: Comply with MSS SP-69, “Pipe Hangers and Supports C Selection and Application,” “latest edition”, and SP-89, “Pipe Hangers and Supports -- Fabrication and Installation Practices,” “latest edition”. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. Piping shall be supported independently from equipment connections. Supports shall not interfere with removal of equipment.

1. At locations where cable assemblies’ restraints are located, the support rods must be braced when necessary to accept compressive loads.
2. At all locations where cable assemblies’ restraints are attached to pipe clevis’s, the clevis cross bolt must be reinforced.

B. Seismic restraints, shall be provided for all installed plumbing equipment having a component importance factor of 1.5 where the Seismic Design Category is C or importance factor of 1.0 where the Seismic Design Category is D, E, or F.

C. Installation of vibration isolators and seismic restraints must not cause any change of position of equipment, or piping resulting in stresses or misalignment.

D. Vibration isolated seismic restraints.

1. The contractor shall not install seismic restraints on vibration isolated equipment and systems which makes rigid connections with the building.

2. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

    a. Cable restraints shall be installed slightly slack to avoid short circuiting the vibration isolated suspended equipment, piping or conduit.
    b. Cable assemblies are installed taut on non-vibration isolation systems. Seismic solid braces may be used in place of cables on rigidly attached systems only, but cable restraints are the preferred method of installation. Hose fittings and accessories shall be unbraided type 304 stainless steel with a minimum bend radius of 4 inches, fittings and accessories shall be UL 2443 listed for sprinkler services to 175 psi.
    c. Restraints shall have a positive connection to the building structure. Connections made to drywall or other nonbuilding structure are not acceptable.

E. Seismic restraints for non-vibration isolated systems:

1. At locations where specification 12 or 13 restraints are located, the support rods must be braced when necessary to accept compressive loads with specification 14 braces.

F. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.

G. Install supports with maximum spacings complying with MSS SP-69, "Pipe Hangers and Supports C Selection and Application," "latest edition", and as specified in Section Building Services Piping.

3.5 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT

A. General

1. Locations of vibration isolation equipment shall be selected for ease of inspection and adjustment as well as for proper operation.
2. Installation of vibration isolation equipment shall be in accordance with manufacturer's written instructions.
3. Seismic restraints, if applicable, shall be provided for all installed mechanical equipment having a component importance factor of 1.5.

B. Thrust Restraints

1. Attach thrust restraints at centerline of thrust and symmetrically on each side of equipment generating thrust.
2. Adjust restraints to limit equipment movement to specified limit.

C. Resilient Penetration Sleeve/Seals

1. Penetration seals shall maintain airtight seal around penetrating element and shall prevent contact of penetrating element and building structure. Fit sleeve tightly to building construction and with acoustical sealant seal airtight on both sides of construction penetrated.

3.6 SEISMIC RESTRAINT OF PIPING

A. Transverse piping restraints shall be at 40’ maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads. Spacing shall be reduced to 20’ maximum spacing for piping containing hazardous/flammable materials and/or built from nonductile materials such as cast iron and PVC. Minimum of two transverse restraints are required per pipe run.

B. Longitudinal restraints shall be at 80' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads. Spacing shall be reduced to 40’ maximum spacing for piping containing hazardous/flammable materials and/or built from nonductile materials such as cast iron and PVC. Minimum of one longitudinal restraint is required per pipe run.

C. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.

D. For fuel oil and all gas piping transverse restraints must be at 20’ maximum and longitudinal restraints at 40’ maximum spacing.

E. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24” of the elbow or TEE or combined stresses are within allowable limits at longer distances.

F. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.

G. Branch lines may not be used to restrain main lines.

H. Cast iron pipe of all types, glass pipe and any other pipes joined with a four band shield and clamp assembly shall be braced as in sections 3.3.B. and C.

3.7 SEISMIC RESTRAINT EXCLUSIONS

A. Pipe Exclusions

1. All piping less than 2 1/2" inside diameter.
2. All piping suspended by clevis hangers where the distance from the top of the pipe to the suspension point is 12" or less for all connection points for the entire pipe run provided that all connections avoid the possibility of significant bending of the hanger rod (swivel connections and/or vibration isolated hangers satisfy this).
3. All trapezed piping where the distance from the suspension point to the trapeze member is 12" or less for all connection points for the entire pipe run provided that all connections

avoid the possibility of significant bending of the hanger rod (swivel connections and/or vibration isolated hangers satisfy this).

4. If any suspension location in the run exceeds the above, the entire run must be braced.

3.8 APPLICATIONS FOR VIBRATION CONTROLS

A. Major Equipment

1. Unless otherwise shown or specified, major floor-mounted equipment shall be set on housekeeping type concrete pads. See architectural or structural drawings for details.
2. Thrust Restraints shall be installed on equipment as called for in schedule on drawings or specified hereunder.
3. Electrical connections to vibration-isolated equipment exposed to weather shall be Unit FEC-A.
4. Electrical connections to vibration-isolated equipment located indoors shall be Unit FEC-B.

B. Pipes

1. Isolators for first three support points adjacent to connected equipment shall achieve half of specified static deflection of isolators supporting connected equipment. When required static deflection of these pipe isolators is greater than 0.50," Unit FSN or HSN isolators, (whichever is applicable for mounting condition) shall be used.
2. Where lateral support of pipe risers is required within specified limits, use resilient lateral supports.
3. Pipes within specified limits that penetrate building construction shall be isolated from building structure by (Unit RPS-A or Unit RPS-B) resilient penetrating sleeve/seals.
4. Drain piping connected to vibration-isolated equipment shall not contact building structure or other non-isolated system unless it is resiliently mounted as described above.

3.9 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Adjust for pipe alignment and final equipment connections. Flexible connections shall not be used for adjustment of alignment.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, and the other sections of Division 022.

1.2 SUMMARY

A. Section Includes:

Engraved Plastic-Laminate Signs.

1. Valve Tags.
2. Painted Identification Materials.
3. Plastic Pipe Markers.
4. Underground-Type Plastic Line Marker.
5. Ceiling Tacks
6. Plasticized Tags.

B. Related Sections The following Sections contain requirements that relate to this Section:

1. Division 09 Section: “Painting and Coating”: Execution requirements for painting specified by this section.
2. Division 22 Section: “Common Work Results for Plumbing.”
3. Division 22 Section: “Plumbing Pumps.”
4. Division 22 Section: “Pipes and Tubes for Plumbing Piping and Equipment.”
5. Division 22 Section: “General Duty Valves for Plumbing Piping.”
6. Division 22 Section: “Plumbing Fixtures.”

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”)

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.4 SUBMITTALS

A. Division 01 Section: “Submittal Procedures”: Submittal Procedures.

B. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

E. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8 1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. Furnish copies for Maintenance Manuals as specified in Division 01 Section: “Execution and Closeout Requirements.”

F. Maintenance Data: Include product data and schedules in maintenance manuals, in accordance with requirements of Division 01.

G. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

H. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

I. Comply with VOC limitations under section 099100.

J. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.5 CLOSEOUT SUBMITTALS

A. Division 01 Section: “Execution and Closeout Requirements”: Closeout procedures.

B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1, for lettering size, length of color field, colors, and viewing angles of identification devices.

C. Equipment Lettering and Graphics:

1. General: Coordinate names, abbreviations and other designations used in plumbing identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of plumbing systems and equipment.

    a. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification, which indicates individual system number as well as service (for example; Water Heater No. 3).

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS

A. Division 01 Section: “Administrative Requirements:”: Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 EXTRA MATERIALS

A. Division 01 Section: “Execution and Closeout Requirements": Spare parts and maintenance products.

B. Furnish two containers of spray-on adhesive

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering identification materials which may be incorporated in the work include, but are not limited to, the following:

1. Brady (W.H.) Co.; Signmark Div.
2. Industrial Safety Supply Co., Inc.
3. Seton Name Plate Corp.

2.2 MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 22 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

B. Provide pipe markers with the following background colors and designations:

SERVICE	STENCIL DESIGNATION	LETTER COLOR	BACKGROUND COLOR	JACKET
Sanitary/Vent	Sanitary Sewer/Vent	White	Safety Green	Brown
Storm Water/Rain Leaders	Storm Water	White	Safety Green	Purple
Domestic Cold Water	Domestic Cold Water	White	Safety Green	Blue
Domestic Hot Water	Domestic Hot Water (F)	White	Safety Green	Red
Domestic Hot Water Return	Domestic Hot Water Return (F)	White	Safety Green	Red
Condensate Drain	Drain Water	White	Safety Green	Tan
Fuel Oil Supply	Fuel Oil Supply	Black	Safety Yellow	Yellow
Fuel Oil Return	Fuel Oil Return	Black	Safety Yellow	Yellow

2.3 ENGRAVED PLASTIC-LAMINATE SIGNS (Nameplates):

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/8", except as otherwise indicated.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

D. Nomenclature: Include the following, matching terminology on schedules as closely as possible:

1. Name and plan number.
2. Equipment service.

3. Design capacity.
4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.

E. Size: Provide approximate 2 1/2" x 4" markers for control devices, dampers, and valves; and 4 1/2" x 6" for equipment.

2.4 VALVE TAGS:

A. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32" thick engraved plastic laminate valve tags, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.

1. Provide 1 1/2" sq. black tags with white lettering, except as otherwise indicated.
2. Provide size, shape and color combination as specified or scheduled for each piping system.

B. Plastic Valve Tags: Provide manufacturer's standard solid plastic valve tags with printed enamel lettering, with piping system abbreviation in approximately 3/16" high letters and sequenced valve numbers approximately 3/8" high, and with 5/32" hole for fastener.

1. Provide 1 1/8" sq. white tags with black lettering.
2. Provide size, shape and color combination as specified or scheduled for each piping system.

C. Metal Tags:

1. Brass with stamped letters; tag size minimum 1-1/2 inches square with finished edges.

D. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

E. Tag Chart: Typewritten letter size list of applied tags and location in anodized aluminum frame

2.5 PAINTED IDENTIFICATION MATERIALS:

A. Stencils: With clean cut symbols and letters of following size:

1. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2 inch high letters.
2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
3. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
4. Ductwork and Equipment: 1-3/4 inches high letters

B. Stencils shall not be utilized on piping and plumbing equipment.

C. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

D. Identification Paint and Background Color; Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems and plumbing equipment comply with ANSI A13.1 for colors.

2.6 PLASTIC PIPE MARKERS:

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, UV-resistant color-coded pipe markers, complying with ANSI/ASME A13.1

B. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1 1/2".

C. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:

1. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1 1/2" wide; full circle at both ends of pipe marker, tape lapped 3".
2. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

D. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.

1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.

2.7 UNDERGROUND TYPE PLASTIC LINE MARKER:

A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates the type of service of buried pipe.

1. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.8 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color-coded head.

B. Color code as follows:

1. Plumbing valves: Green.

2.9 PLASTICIZED TAGS:

A. General: Manufacturer's standard pre-printed or partially pre- printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3 1/4" x 5 5/8", with brass grommets and wire fasteners, and with appropriate pre- printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. General:

1. Coordination: Where identification is to be applied to surfaces, which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
2. Confined Spaces: Provide labels and signs on all duct and equipment doors, plenums, etc. to indicate service and provide operator warnings as required by OSHA, NFPA, and authority having jurisdiction.

B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

D. Piping System Identification:

1. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:

    a. Plastic pipe markers, with application system as indicated under "Materials" in this section.
2. Locate pipe markers and color bands as follows on all piping in occupied spaces, above ceilings, machine rooms, accessible maintenance spaces (shafts, plenums) and exterior non-concealed locations.

    a. Near each valve and control device.
    b. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
    c. Near locations where pipes pass through walls or floors/ ceilings, or enter non-accessible enclosures.
    d. At access doors, manholes and similar access points, which permit view of concealed piping.
    e. Near major equipment items and other points of origination and termination.

f. Spaced intermediately at maximum spacing of 25' along each piping run, except reduce spacing to 10' in congested areas.

3. Labeling of water distribution pipes in bundles:

a. Where water distribution piping is bundled at installation, each pipe in the bundle shall be identified per project specification. The identification shall indicate the pipe contents and the direction of flow in the pipe. The interval of the identification markings on the pipe shall not exceed 25 feet. There shall be not less than one identification label on each pipe in each room, space, or story.

E. Underground Piping Identification:

1. General: During back-filling/top-soiling of each exterior underground piping system, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

F. Valve Identification:

1. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures. List each tagged valve in valve schedule for each piping system.

Equipment Identification:

2. General: Install engraved plastic laminate sign on or near each major item of plumbing equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

a. Water meters and flow meters.
b. Pumps, compressors, and similar motor- driven units.
c. Expansion tanks, and similar equipment.
d. Tanks and pressure vessels.
e. Filters, water treatment systems and similar equipment.
f. Domestic water heater, sumps,etc.

3. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.
4. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety precautions, and warn of hazards and improper operations.

G. Provide ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.3 ADJUSTING

A. Adjusting: Relocate any identification device, which has become visually blocked by work of this division or other divisions.

3.4 CLEANING

A. Division 01 Section: “Execution and Closeout Requirements”: Requirements for cleaning.

B. Cleaning: Clean face of identification devices.

3.5 EXTRA STOCK

A. Furnish minimum of 5% extra stock of each identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

END OF SECTION

SECTION 22 05 93
TESTING, ADJUSTING AND BALANCING FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including the General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other Sections of Division 22.

1.2 SUMMARY

A. Coordinate work of this section with all trades.

B. Work covered in this Section shall be performed after completion of work specified in all Divisions as they related to this work.

C. Review of design drawings and specifications, and comment on potential problem areas.

D. Site inspections of ongoing plumbing installation with written report from each visit.

E. Measurement and setting of all domestic hot water systems provided or specified in accordance with these contract documents, recording data, making tests, and preparing reports, all as hereinafter specified.

F. Coordinate with all trades to provide all incidental items not indicated on drawings or in specifications that belong to work described or are required for complete systems balancing, at no additional cost to Owner.

G. Refer to paragraph “Closeout Submittals” in Division 22 Section: “Common Work Results for Plumbing.”

1.3 SUBMITTALS

(Unless otherwise noted, references apply to “latest edition”.)

A. Division 01 Section: “Submittal Procedures”: Submittal Procedures.

B. Agency Data:

1. Submit proof that proposed testing, adjusting, and balancing agency meets the qualifications specified within 30 days of award of contract.

C. Engineer and Technicians Data:

1. Submit proof that Test and Balance Engineer assigned to supervise procedures, and technicians proposed to perform procedures meet qualifications specified within 30 days of award of contract.

D. Procedures and Agenda: Submit synopsis of testing, adjusting, and balancing procedures and agenda proposed to be used for this project within 90 days of award of contract.

E. Document Review:

1. Submit certification in writing that all design drawings and specifications have been reviewed, and comment on potential problems within 90 days of award of contract.

F. Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems. Include this information in maintenance data specified in Division 01 and Division 22 Section: “Common Work Results for Plumbing.”

G. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of Test and Balance Engineer. Reports shall be certified proof that systems have been tested, adjusted, and balanced in accordance with referenced standards; are an accurate representation of how systems have been installed; are true representation of how systems are operating at completion of testing, adjusting, and balancing procedures; and are accurate record of final quantities measured, to establish normal operating values of the systems. Follow procedures and format specified below:

1. Report Format: Report forms shall be those standard forms prepared by referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with project identification and a title descriptive of contents. Divide contents of binder into divisions listed below, separated by divider tabs:

    a. General Information and Summary
    b. Domestic hot Water Systems
    c. Automatic Temperature Controls
    d. Special Systems

2. Report Contents: Provide following minimum information, forms and data:

    a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project. Include addresses, and contact names and telephone numbers. Include certification sheet containing seal and name address, telephone number, and signature of Certified Test and Balance Engineer. Include in this division listing of the instrumentations used for the procedures along with proof of calibration.
    b. Remainder of the report shall contain appropriate forms containing as minimum, information indicated on standard report forms prepared by AABC and NEBB, for each respective item and system. Prepare schematic diagram for each item of equipment and system to accompany each respective report form.

H. NIST Calibration Reports: Submit proof that all testing and balancing instruments and equipment used for this project has been calibrated in accordance with NIST Standards, within period of twelve months prior to starting project.

I. Final submittal shall include but not be limited to following:

1. List of equipment used to perform test and procedures.
2. Equipment performance data and equipment curves with actual points of performance indicated on curves as compiled during balancing.
3. Domestic hot water system component flow rates, pressures and temperatures.
4. On balance report documents record date and time of reading.

J. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.4 QUALITY ASSURANCE

(Unless otherwise noted, references apply to "latest edition")

A. Agency Qualifications:

1. Employ services of independent testing, adjusting, and balancing agency meeting qualifications specified below, to be single source of responsibility to test, adjust, and balance the building domestic hot water systems to produce design objectives. Services shall include checking installations for conformity to design, measurement and establishment of fluid quantities of plumbing systems as required to meet design specifications, and recording and reporting results.
2. Certified by National Environmental Balancing Bureau (NEBB) or by Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in State in which services are to be performed, certified by NEBB or AABC as Test and Balance Engineer.

B. Work shall be accomplished in accordance with specifications. Procedures specified shall be followed and, if not specifically described herein, in general, shall be in accordance with Associated Air Balance Council's National Standards or National Environmental Balancing Bureau's Procedural Standards.

C. Design Review:

1. Review all design drawings and specifications. Review shall include:

   a. Control device location and balancing devices location in piping systems.
   b. Indicate additional balancing devices required for proper balancing.
   c. Specifications on all devices required for balancing.
   d. Note any potential noise problems.
2. Within 90 days of award of contract, meet with the Architect, Mechanical Contractor, and Building Automation System Contractor to review procedures and agenda and comments on design documents as to potential problem areas.

D. Shop Drawing Review:

1. Review "Instrumentation and Control for HVAC" shop drawing submittals noting any potential balancing problems. Note comments on submittal, sign, stamp and return to General Contractor. All "Instrumentation and Control for HVAC" submittals must be reviewed by balancing agency prior to review by Architect.

E. Pre-Balancing Conference: Prior to beginning of testing, adjusting, and balancing procedures, schedule and conduct conference with Architect and representatives of installers of mechanical systems. Objective of conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

F. During construction, balancing agency shall inspect the installation of pipe systems, temperature controls, and other component parts of plumbing system. Inspections shall be performed periodically as work progresses. Minimum of two inspections are required as follows: (1) when 60 percent of piping is installed; (2) when 90 percent of equipment is installed. Balancing agency shall submit brief written report of each inspection to Owner and Architect.

G. Standards:

1. Associated Air Balance Council (AABC) Publication:

   a. National Standards for Testing and Balancing Heating, Ventilating and Air Conditioning Systems, Latest Edition.
   b. NSF/ANSI 61 & Annex G: Drinking Water Systems Components – Health Effects.
   c. NSF/ANSI 372: Drinking Water Systems Components – Lead Content.
2. American Society of Heating, Refrigeration and air Conditioning Engineers (ASHRAE) Publications:

   a. "ASHRAE Research Report No. 1162, "Air Flow Measurements at Intake and Discharge Openings and Grilles," ASHVE Transactions, Volume 46.
   b. ASHRAE Handbook of Fundamentals, Latest Edition.
3. National Environmental Balancing Bureau (NEBB)

   a. Procedural Standards for Testing-Balancing- Adjusting of Environmental Systems, Latest Edition.

1.5 OWNER'S INSTRUCTIONS

A. Balancing contractor's technician along with his balancing engineer shall provide four (4) hours of instruction to Owner's engineers on balancing methods, procedures and equipment.

PART 2 - PRODUCTS

A. Interior wet-applied paints, and coatings: Comply with emissions requirements of CDPH Standard Test Method and VOC content limits in Section 018113.

B. Composite wood: Comply with low-emitting requirements of CARB, NAF or applicable standard in Section 018113.

PART 3 - EXECUTION

3.1 SYSTEM BALANCE - GENERAL REQUIREMENTS

A. Balance domestic hot water systems to obtain water quantities indicated and required for proper operation of system.

B. Field work performed under this Section shall be provided under direct supervision of a Registered Professional Engineer.

C. Furnish services for complete adjustment of water system distribution and controls.

D. During all tests, it shall be demonstrated that systems shall be free from leaks and all parts of system will operate correctly. If not, report deficiencies to Contractor and Owner. Balancing Firm shall make final adjustments to system as may be required for proper operation, maintaining correct flow rates in all parts of the building.

E. Preliminary Work:

1. Inspect project site prior to starting adjustments to verify completion of trades, including general construction, piping system, building automation systems, and electrical systems, as they relate to balancing work. Verification shall include but not be limited to following:

    a. Piping System (domestic hot water):
    b. Already cleaned and flushed by mechanical contractor.
    c. System filled and vented of air under Division 22.
    d. Proper direction of rotation for motor-driven equipment and for proper speed on multi-speed motors.
    e. Balancing devices are installed and accessible.
    f. Control device connections.
    g. Note problems in general construction of the building that might effect systems performance such as sealing of windows, building joints, exhaust shafts, etc.
    h. Problems discovered during this inspection shall be reported to General Contractor and Owner.

2. Contractor shall certify in writing that each piping system has been prepared as per this Section, indicating dates procedures were done and which contractor did work. Submit in writing to Architect before beginning balancing work.

F. Balancing of domestic hot water circulation systems and parts installed under this Contract to obtain water quantities and temperature drops in all parts of system shown on plans, in specifications on approved shop drawings or as required by Architect.

3.2 DOMESTIC HOT WATER SYSTEM BALANCE

A. In conjunction with Instrumentation and Controls System Technician, pumps shall be started per design sequence. With manual valves open, and control valves in normal position, adjust discharge balancing valve to obtain design flow. Compare data with pump submittal curve. If test point falls on curve, proceed with balancing. If recorded data does not fall on pump curve, plot new curve parallel with other curves on chart, from zero to maximum flow. Open discharge balancing valve to full and record discharge pressure, suction pressure and total head.

Readjust balancing valve to obtain suction and discharge design flow and pressure, and record data. Check and record pump motor voltage and amperage. Pump motor shall not be overloaded.

B. With pump system adjusted, perform following tests, compile data and submit report:

1. Pumps:

a. Design Data
   1) Flow and total dynamic head.
   2) Pump speed, and motor output.
b. Installed equipment
   1) Manufacturer, size and model number.
   2) Type drive.
   3) Motor rating, voltage, and phase.
   4) Full-load amperes.
c. Field Test
   1) Discharge pressures: Full flow and zero flow.
   2) Suction pressures: Full flow and zero flow.
   3) Operating flow and total dynamic head
   4) No-load amperes (where possible.)
   5) Full-flow amperes, zero-flow amperes.
   6) Calculated motor output.

C. With pump system properly adjusted, proceed with following tests adjustments and compilation of data:

1. Pipe Mains and Branches:

a. Adjust branch balancing valves to obtain pressure and flowrates required.
b. Provide the following:
   1) Manufacturer's model number, size of heat exchanger, number of passes.
   2) Design and actual flow rate and pressure drop.
c. Heat transfer equipment including domestic hot water.
   1) Measured Parameters
      a) Flowrate.
      b) Heat transfer.
      c) Entering and leaving temperatures.
      d) Pressure drops.
   2) Equipment data
      a) Manufacturer and model number.
      b) Motor output horsepower.
      c) Serial numbers.
   3) Design Data
      a) Include design data in submittal for comparison.

3.3 CALIBRATION

A. During testing and balancing, inspect temperature sensors, pressure sensors, digital indicators, and thermometers, etc. provided under Division 22. Report discrepancies to the Contractor for replacement or recalibration.

3.4 RE-BALANCE

A. After Architect's review of test and balance report submittal, make adjustment in any balancing point as required by Architect, to correct discrepancies between balance report and design, at no additional cost.

3.5 FINAL BALANCE

A. Visit site within one year after building occupancy if necessary to adjust and rebalance, any system required by Owner, to resolve any and all complaints. After final balance, revise previous submittal and resubmit to architect for record purpose. Rebalance and resubmittals shall be done at no additional cost to Owner.

3.6 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section: “Commissioning”.

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable.

END OF SECTION

SECTION 22 07 00
PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplemental Conditions and Division 01 Specifications, apply to this section and the other sections of Division 22.

1.2 SUMMARY

A. This section Includes:

1. Insulation Materials:
    a. Cellular glass.
    b. Flexible elastomeric.
    c. Glass Mineral Wool
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Sealants.
6. Factory-applied jackets.
7. Field-applied fabric-reinforcing mesh.
8. Field-applied cloths.
9. Field-applied jackets.
10. Tapes.
11. Securements.
12. Corner angles.
13. Insulation for handicapped fixtures.

B. Related Sections: The following sections contain requirements that relate to this section.

1. Division 07 Section: “Firestopping:” Product requirements for firestopping for placement by this section.
2. Division 09 Section: “Painting and Coating:” Execution requirements for painting insulation jackets and covering specified by this section.
3. Division 22 Section: “Hangers and Supports for Plumbing Piping and Equipment:” Product and Execution requirements for inserts at hanger locations.
4. Division 22 Section: “Identification for Plumbing Piping and Equipment:” Product requirements for plumbing piping and equipment identification.

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”)

A. ASTM International:

1. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
3. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
4. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
5. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
6. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
7. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
8. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
9. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
10. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
11. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
12. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
13. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
14. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
15. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
16. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
17. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
18. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
19. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
20. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
21. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
22. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
23. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
24. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
25. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
26. ASTM C1393 - Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks.
27. ASTM C1617 – Standard Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals
28. ASTM C1639 – Standard Specification for Fabrication of Cellular Glass Pipe and Tubing Insulation
29. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

30. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120.
31. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
32. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
33. ASTM E2231 – Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics

B. Underwriters Laboratories Inc.:

1. UL 723 – Standard Test Method for Surface Burning Characteristics of Building Materials

C. American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE).

D. North American Insulation Manufacturers Association (NAIMA).

E. NAIMA – "Guide to Insulating Chilled Water Piping Systems with Mineral Fiber Pipe Insulation."

F. "National Commercial & Industrial Insulation Standards" – MICA Manual.

G. National Fire Protection Association (NFPA).

H. Underwriter's Laboratories Environmental (UL Environment).

1.4 SUBMITTALS

A. Division 01 Section: “Submittal Procedures”: Submittal Procedures.

B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.

C. EPD Submittals: As certified by UL Environment

D. Samples: Submit two samples of representative size illustrating each insulation type.

E. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Comply with VOC limitations under section 099100.

H. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.5 QUALITY ASSURANCE

A. Pipe Insulation shall be UL/ULC Classified per UL 723 or have maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84 using specimen procedures and mounting procedures of ASTM E 2231.

B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

D. Perform Work in accordance with all applicable codes, standards and local authorities having jurisdiction requirements.

E. Fire-Test-Response Characteristics: Insulation and related materials shall be UL/ULC Classified per UL 723 or have fire-test response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

F. Insulation materials shall be tested and rated according to ASTM Test Method C-177 to determine k-factors. ASTM C 335 is for pre-formed pipe insulation. Note: C177 is for flat slab materials ONLY; such as board products, etc.

G. Formaldehyde Free: Third party certified with UL Environment Validation.

H. Biosoluble: As determined by research conducted by the International Agency for Research on Cancer (IARC) and supported by revised reports from the National Toxicology Program (NTP) and the California Office of Environmental Health Hazard Assessment. Certified by European Certification Board for Mineral Wool Products (EUCEB).

I. Products shall contain no polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE fire retardants: have been linked to adverse health effects after exposure in low concentrations.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years experience.

1.7 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section: “Product Requirements”: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping. Remove and replace any wet or damaged unsatisfactory insulation at the architect’s direction.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section: “Product Requirements”: Environmental conditions affecting products on site.

B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

C. Maintain temperature during and after installation for minimum period of 24 hours.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

A. Division 01 Section: “Execution and Closeout Requirements”: Product Warranties and product bonds.

B. Furnish two year manufacturer warranty for man made fiber.

1.12 COORDINATION

A. Division 01 Section: “Administrative Requirements”: Requirements for coordination.

B. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 22 Section: “Hangers and Supports for Plumbing Piping and Equipment.”

C. Coordinate clearance requirements with piping Installer for piping insulation application, and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.13 DEFINITIONS

A. Thermal Conductivity (K value): Units of Btu-inch/hour per square foot per degree F.

B. UL GREENGUARD: Provides independent third party, Indoor Air Quality (IAQ) certification of products for emissions of respirable particles and Volatile Organic Compounds (VOC's), including formaldehyde and other specific product related pollutants. Certification is based upon criteria used by EPA, OSHA, and WHO.

C. EPA: Environmental Protection Agency.

D. WHO: World Health Organization.

E. ASJ+: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with a polypropylene outer film layer leaving no paper exposed.

F. ASJ: Al-service jacket.

G. FSK: Foil, scrim, Kraft paper.

H. FSP: Foil, Scrim, polyethylene.

I. PVDC: Polyvinylidene chloride.

J. SSL+: Self-Sealing Lap with Advanced Closure System.

K. SSL: Self-sealing lap.

L. ASJ Max: All service jacket composed of aluminum foil with tri-directional reinforcing scrim bonded to Kraft paper with a polypropylene outer layer leaving no exposed paper.

M. PSK: Poly Scrim Kraft.

N. PVC: Polyvinyl Chloride.

O. Glass Mineral Wool: Interchangeable with fiber glass, but replacing the term in the attempt to disassociate and differentiate Glass Mineral Wool from the potential health and safety of special purpose or reinforcement products that do not meet the bio solubility criteria of insulation made from glass. Rock Mineral Wool will replace the traditional Mineral Wool label. Both are used in lieu of the Mineral Fiber label.

P. ECOSE® Technology: a revolutionary binder chemistry that enhances the sustainability of products. The "binder" is the bond that holds the Glass Mineral Wool product together and gives the product its shape and brown color. ECOSE Technology is a plant based sustainable chemistry that replaces the phenol/formaldehyde (PF) binder traditionally used in Glass Mineral Wool products. Products using ECOSE Technology are formaldehyde free and have greater reduced global warming potential than compared to products of the past.

Q. UL GREENGUARD Gold Certification: (formerly known as GREENGUARD Children & Schools Certification) offers stricter certification criteria, considers safety factors to account for sensitive individuals (such as children and the elderly), and ensures that a product is acceptable for use in environments such as schools and healthcare facilities. It is referenced; by both The Collaborative for High Performance Schools (CHPS) and the Leadership in Energy Environmental Design (LEED) Building Rating Systems.

R. UL Environment Formaldehyde Free Verification Requirements: For a product to be verified as formaldehyde free, product samples must have a measured emission factor of less than or equal

to 5 µg/m²h at 24 elapsed hours or 3 µg/m²h at 336 elapsed hours. An emission factor of 5 µg/m²h corresponds to measured chamber concentration of 2.5 µg/m³ for a typical building ratio of 0.5 m²/m³. This chamber concentration is comparable to, or below typical outdoor air concentrations. This demonstrates that the formaldehyde exposure from products labeled as formaldehyde free will not contribute to airborne formaldehyde concentrations at greater levels than those found in the natural outdoor environment.

S. Imperative 11, Red List – requires that manufacturers disclose the ingredients in their products to insure that they are free of Red List chemicals and materials. The Red List represents the "worst in class" materials, chemicals and elements known to pose serious risks to human health and the greater ecosystem.

T. Underwriters Laboratories Environment (UL Environment): offers independent green claims validation, product assessment and certification. UL GREENGUARD provides third party credibility for sustainable products.

U. UL Environment Claims Validation (ECV): service and label tests a manufacturer's product and validates that the environmental claims they make in their marketing and packaging materials are factual. This Environmental Claims Validation (ECV) service will allow manufacturers to verify that their products contain a quantifiable amount of recycled content and, as such, help limit raw material extraction and reduce landfill waste. It also will enable products to qualify for LEED® points under Pilot Credit 43: MR – Certified Products.

V. EUCEB: exonerated fiber from a health and safety standpoint by the European Certification Board process.

W. Recycled Content: materials such as bottled glass collected at curbside or other collection sites after consumer use and/or materials used or created from one manufacturing process which are collected as scrap and placed back into another manufacturing process rather than being placed in a landfill or incinerated.

X. Polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE fire retardants: have been linked to adverse health effects after exposure in low concentrations.

Y. UL Classified: UL has tested and evaluated samples of the product with respect to certain properties of the product. UL Classifies products to:

1. Applicable UL requirements.
2. Standards for safety.
3. Standards of other National and International organizations.

Z. EPD: Environmental Product Declaration. A third party verified document that reports environmental data of products based on the Life Cycle Assessment (LCA) and other relevant information, and in accordance with the International Standard ISO 14025 (Type III Environmental Declarations).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection.

1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INSULATION MATERIALS

A. Refer to Part 3 execution: schedule for requirements regarding where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Insulation products shall contain no formaldehyde-based binders or shall be third-party certified for conformance with GREENGUARD Gold or Indoor Advantage Gold. (GREENGUARD Children and Schools is now called GREENGUARD Gold)

D. When product to be in contact with austenitic stainless steel is tested according to ASTM C795 (which includes ASTM C692 and ASTM C871), the PH of the leach water from the specific material supplied shall be greater than 7.0 but not greater than 11.7 at 77°F (25°C). An acceptable proportion of sodium plus silicate ions to the chloride ions as found by leaching from the insulation is shown in the “plot point” of figure 6 in ASTM C795.

E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

F. Insulation materials applied to carbon steel shall be Mass Load Corrosion Rate (MLCR) tested per ASTM 1617.

G. Cellular Glass: Inorganic, incombustible, foamed or celluated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in Part 2 “Factory-Applied Jackets” Article.

1. Products:

    a. Pittsburgh Corning; FOAMGLAS® ONE™ Insulation.
    b. Specialty Products & Insulation Company (SPI), Lancaster, PA., Cellular, glass fabricator.
2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Grade 6.
6. Maximum K-Factor: 0.29 at 75 deg. F. mean temperature.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

H. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products:

   a. Aeroflex USA Inc.: Aerocel.
   b. Armacell LLC; AP Armaflex (rectangular)
   c. Armacell LLC; AP Coilflex (round/oval)
   d. Nomaco; K-Flex Pipe
2. Water Vapor Permeability: 0.02 perm-inch per ATM E96 Procedure A.
3. Thermal Conductivity: 0.27 at 75 degrees F
4. Warranty: 25 year warranty against breakdown of the membrane due to ultraviolet radiation.
5. Seal Tape: Thermoplastic rubber membrane backed with pressure sensitive adhesive.

I. Glass Mineral Wool Blanket Insulation: Glass mineral wool bonded with a thermosetting resin. Comply with ASTM C 553, Types I, II and III, ASTM C 1136, Type II and ASTM C 1290, Type I or Type III, UL/ULC Classified per UL 723 or FHC 25/50 per ASTM E 84. UL GREENGUARD Gold Certified and Validated to be formaldehyde free by UL Environment. Product shall contain no polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE. Factory applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 “Factory-Applied Jackets” Article.

J. Glass Mineral Wool Board Insulation: Glass mineral wool bonded with a thermosetting resin. UL/ULC Classified per UL 723 or FHC 25/50. Comply with ASTM C 612, Type IA or Type IB. Living Building Challenge – Declare Red List Free. For equipment applications, provide insulation with factory-applied ASJ+. Factory-applied jacket requirements are specified in Part 2 “Factory-Applied Jackets” Article.

1. Products:

   a. Knauf Insulation; Earthwool Insulation Board with ECOSE Technology
   b. CertainTeed Corp.; Commercial Board.
   c. Johns Manville; 800 Series Spin-Glas, Type 814.
   d. Owens Corning; Fiberglas 700 Series.
2. Thermal Conductivity: 0.23 at 75 degrees F

K. Glass Mineral Wool, Preformed Pipe Insulation:

1. Products:

   a. Johns Manville; Micro-Lok HP Ultra
   b. Knauf Insulation; Earthwool 1000 Pipe insulation with Ecose® Technology.
   c. Knauf Insulation; Earthwool Redi-Klad 1000 Pipe insulation with Ecose® Technology. . (for chilled water or outdoor applications)
   d. Owens Corning; Fiberglas Pipe Insulation SSLII with ASJ Max.
2. Type I, 850 deg F or Type IV, 1000 deg F. Materials: Glass mineral wool bonded with a thermosetting resin. UL/ULC Classified per UL 723 or FHC 25/50 per ASTM E 84. Living Building Challenge – Declare Red List Free for Redi-Klad Pipe or unjacketed Earthwool Pipe only. Comply with ASTM C 585, ASTM C 411, ASTM C 795 and ASTM C 547, Type I and Type IV, with factory-applied ASJ+ - SSL+ or ASJ+ - SSL. Factory-applied jacket requirements are specified in Part 2 “Factory-Applied Jackets” Article.

3. Type II, 1200 degree F Materials: Mineral or glass fibers bonded with thermosetting resin. Comply with ASTM C547, Type II, Grade A, with Factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 “Factory-Applied Jackets” Article.
4. Maximum K-Factor: 0.23 at 75 deg. F mean temperature; 0.34 at 250 deg. F mean temperature.

L. Glass Mineral Wool, Pipe and Tank Insulation: Glass mineral wool bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ Max, ASJ+, or PSK complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Factory-applied jacket requirements are specified in Part 2 “Factory-Applied Jackets” Article.

1. Products:

a. Certain Teed Corp.; CrimpWrap.
b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation, with Ecose® Technology - 850°F.
d. Knauf Insulation; Kwik Flex Pipe & Tank Insulation -850° F with Ecose ® Technology.
e. Owens Corning; Fiberglas® Pipe and Tank Insulation with white ASJ Max for systems operating at temperatures to 650°.
f. Owens Corning; Flexwrap for operating temperatures up to 850°

2. Maximum K-Factor: 0.29 at 100 deg F. Mean temperature; 0.45 at 300° F Mean temperature Minimum Density: 2.5 pounds per cubic foot.
3. Minimum Density: 2.5 pounds per cubic foot.

2.3 INSULATING CEMENTS

A. Comply with VOC limits specified in Division 01 Section “Sustainable Design Requirements – LEED.”

B. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

C. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

D. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.4 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Comply with VOC limits specified in Division 01 Section “Sustainable Design Requirements – LEED.”

C. Cellular-Glass and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Products:

a. Foster Products Corporation, H. B. Fuller Company; 81-84.
b. Pittsburgh Corning, PC 99 2k Adhesive.

D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I

1. Products:

a. Armacell LCC; Armaflex 520 Adhesive, Armaflex 520 BLV Low-VO Adhesive.
b. Foster Products Corporation, H. B. Fuller Company; 85-60.

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products:

a. Foster Products Corporation, H. B. Fuller Company; 85-70.
b. Eagle Bridges - Marathon Industries, Inc.; 225.

F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products:

a. Foster Products Corporation, H. B. Fuller Company; 85-70.
b. Eagle Bridges - Marathon Industries, Inc.; 225.

G. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products:

a. Dow Chemical Company (The); 739, Dow Silicone.

2.5 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Comply with VOC limits specified in Division 01 Section “Sustainable Design Requirements – LEED.”

C. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products:

a. Foster Products Corporation, H. B. Fuller Company; 30-90.
b. Eagle Bridges - Marathon Industries, Inc.; 590.
c. Mon-Eco Industries, Inc.; 55-40.
d. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.

5. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products:

a. Foster Products Corporation, H. B. Fuller Company; 35-00.
b. Eagle Bridges - Marathon Industries, Inc.; 550.
c. Mon-Eco Industries, Inc.; 55-50.
d. Pittsburgh Corning, PITTCOTE 404 Coating
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

E. Interior wet-applied mastics, paints, and coatings: Comply with emissions requirements of CDPH Standard Test Method and VOC content limits in Section 018113.

2.6 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Comply with VOC limits specified in Division 01 Section “Sustainable Design Requirements – LEED.”
2. Products:

a. Foster Products Corporation, H. B. Fuller Company; 81-42W.
b. Eagle Bridges - Marathon Industries, Inc.; 130.
c. Vimasco Corporation; 713/714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
4. Service Temperature Range: Minus 50 to plus 180 deg F.
5. Color: White.

2.7 SEALANTS

A. Comply with VOC limits specified in Division 01 Section “Sustainable Design Requirements – LEED.”

B. Joint Sealants:

1. Joint Sealants for Cellular-Glass and Polyisocyanurate Products:

a. Foster Products Corporation, H. B. Fuller Company; 30-45.
b. Eagle Bridges - Marathon Industries, Inc.; 405.
c. Mon-Eco Industries, Inc.; 44-05.
d. Pittsburgh Corning Corporation; PITTSEAL® 444Ns Sealant.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.

4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:

1. Products:

a. Foster Products Corporation, H. B. Fuller Company; 95-44.
b. Eagle Bridges - Marathon Industries, Inc.; 405.
c. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

D. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.8 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ+ - SSL+; ASJ+ jacket with Self-Sealing Advanced Closure System; complying with ASTM C 1136 Type I, II, III, IV and VII secured with self-sealing longitudinal laps and matching ASJ+ butt strips.
2. ASJ+: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with a polypropylene outer film layer.
3. ASJ Max: All service jacket made using aluminum foil and tri-directional reinforcing scrim bonded to Kraft paper with polypropylene outer layer complying with ASTM C 1136, Type I.
4. Redi-Klad Jacket: Factory applied venture clad 5-ply weather and abuse resistant with self-sealing lap. Zero permeability per ASTM E 96-05; puncture resistance 35.4 kg (189.3_N) per ASTM D 1000; tear strength 4.3lb (19.4_N) per ASTM D 624, thickness 14.5 mils (0.0145”); tensil strength 68 lb/inch width [306 N (32K9)/25mm.]
5. FSK (FRK) Jacket: Aluminum-foil, fiberglass-reinforced scrim with Kraft-paper backing; complying with ASTM C 1136, Type II.
6. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
7. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according toASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
8. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

a. Products:

1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
2) HiCube Coating: HC1000 Vapor Barrier

9. Vinyl Jacket: UL-rated white vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.
10. PSK Jacket, Polypropylene scrim with Kraft.
11. Aluminum-Polyester Self-Adhesive Jacket: 12 mils (0.22 mm) thick, made with alternating layers of aluminum foil and polyester film coated with cold weather acrylic adhesive. Construction of laminate designed to provide UV resistance, high puncture and tear resistance.

a. Products:
1) Armacell LLC; Armatuff
2) Venture Tape; Venture Clad

2.9 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Comply with VOC limits specified in Division 01 Section “Sustainable Design Requirements – LEED.”

B. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.

1. Products:

a. Vimasco Corporation; Elastafab 894.

C. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.

D. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for duct, equipment, and pipe.

1. Products:

a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.
c. Pittsburgh Corning Corporation; PC Fabric 79.

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Comply with VOC limits specified in Division 01 Section “Sustainable Design Requirements – LEED.”

C. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with Kraft-paper backing.

D. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 30 mil thickness; roll stock Ready for shop or field cutting and forming.

1. Products:

    a. Johns Manville; Zeston.
    b. P.I.C. Plastics, Inc.; FG Series.
    c. Proto PVC Corporation; LoSmoke.
    d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: white
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps and mechanical joints minimum 30 mil thickness.
5. Factory-fabricated tank heads and tank side panels.
6. Provide preformed Fiberglass 1 lb. density 2” thick insulation inserts to comply with ASHRAE 90.1 and ASTM C547 requirements.

E. Metal Jacket:

1. Products:

    a. Childers Products, Division of ITW; Metal Jacketing Systems.
    b. PABCO Metals Corporation; Surefit.
    c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

    a. Sheet and roll stock ready for shop or field sizing.
    b. Thickness:
        1) Up to 24 inch diameter, width, or height: 0.016 inch minimum.
    c. Finish: Smooth finish.
    d. Color: White
    e. Moisture Retarder: 3-mil- thick Polysurlyn (co-extrusion of polyethylene and Dupont Surlyn®, heat laminated to the metal jacketing).
    f. Factory-Fabricated Fitting Covers:
        1) Same material, finish, and thickness as jacket.
        2) Preformed 2-piece or gore, 45- and 90-degree, short- and longradius elbows.
        3) Tee covers.
        4) Flange and union covers.
        5) End caps.
        6) Beveled collars.
        7) Valve covers.
        8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

F. Self-Adhesive Outdoor Jacket: 60-mil thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross laminated polyethylene film covered with stucco-embossed aluminum-foil facing.

1. Products:

a. Polygaurd; Alumaguard 60.
b. MFM Building Products Corp., Flex Clad 400.
c. Venture Clad Jacketing.
d. HiCube Coating Jacketing

G. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Products:

a. Pittsburgh Corning Corporation; PITTWRAP® HS Jacketing.
b. Polyguard; Insulrap No Torch 125.

H. Pipe Sound Lagging: Loaded vinyl with fibrous glass scrim reinforced aluminum foil facing over 2-inch thick quilted fiberglass decoupler. Loaded vinyl shall be 2 psf minimum surface weight. Glass fiber pipe wrap shall be semi-rigid, preformed type, 2- inch minimum thickness, 1-1/2 pcf density.

1. Manufacturers:

a. Kinetics.
b. Sound Seal.
2. Sound Transmission Class (STC) Rating: 26.

2.11 TAPES

A. Comply with VOC limits specified in Division 01 Section “Sustainable Design Requirements – LEED.”

B. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.

1. Products:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
e. HiCube Coating: HC108
2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

C. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.

1. Products:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
b. Compac Corp.; 110 and 111.
c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
e. HiCube Coating: HC106

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

D. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
b. Compac Corp.; 130.
c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
d. Venture Tape; 1506 CW NS.
e. HiCube Coating: HC404

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

E. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.

1. Products:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
b. Compac Corp.; 120.
c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
d. Venture Tape; 3520 CW.
e. HiCube Coating: HC100

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

F. Elastomeric Foam Tape: Black vapor-retarder foam tape with acrylic adhesive containing, EPA approved anit-microbial additive.

1. Products: Subject to Compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Armacell LLC; AP/Armaflex Insulation Tape

2.12 SECUREMENTS

A. Bands:

1. Products:

   a. Childers Products; Bands.
   b. PABCO Metals Corporation; Bands.
   c. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.

   a. Products:
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

   a. Products:
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products:
      1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.
   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106- inch-diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Products:
        1) GEMCO; Nylon Hangers.
        2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
    b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
    c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
    d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inchthick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

    a. Products:
        1) AGM Industries, Inc.; RC-150.
        2) GEMCO; R-150.
        3) Midwest Fasteners, Inc.; WA-150.
        4) Nelson Stud Welding; Speed Clips.
    b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

6. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

    a. Manufacturers:
        1) GEMCO.
        2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Insulation Pipe Hanger Supports: Support piping system using high-density inserts with sufficient compressive strength, embedded within flexible elastomeric foam, with thickness equal to or greater than the pipe insulation.

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but not limited to, the following
        1) Armacell LLC; Armafix IPH

E. Wire: 0.062-inch soft-annealed, stainless steel.

    1. Manufacturers:

        a. ACS Industries, Inc.
        b. C & F Wire.
        c. Childers Products.
        d. PABCO Metals Corporation.

e. RPR Products, Inc.

2.13 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

2.14 HANDICAPPED WHEEL/CHAIR PLUMBING FIXTURE PIPING INSULATION

A. Manufacturer:

1. TRUEBRO, INC. or comparable acceptable product.

B. Product:

1. ADA-conforming, wheelchair accessible lavatory P-trap and angle valve assemblies shall be covered with white, molded, antimicrobial TRUEBRO, INC. Lav Guard 2 under sink pipe covers. Cover shall have internal, E-Z Tear-To-Fit trim feature for square, clean trimming-internal ribs-and built-in, concealed E-Z Grip fasteners (no cable-tie fasteners allowed.)

C. Undersink Protection Systems

1. Provide Lav Shield® ADA-compliant under sink protection to meet requirements for wheelchair accessibility. Single-piece construction shall conceal piping, electronic faucet connections, mixing valves, trap primers and instantaneous hot water heaters. (Lavatory “rough in” shall be considered to allow mounting room for water heater-contact vendor for specifications.) Pre-cut Lav Shield shall be cut to fit various lavatory models.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section: “Execution and Closeout Requirements:” Coordination and project conditions.

B. Verify piping and equipment to be insulated has been tested before applying insulation materials.

C. Verify surfaces to be insulated are clean and dry, with foreign material removed.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 COMMON INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Install insulation continuously through hangers and around anchor attachments.

K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at anchors and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

L. Apply adhesives, mastics, and sealants at manufacturer’s recommended coverage rate and wet and dry film thicknesses.

M. Install insulation with self-sealing factory-applied jackets as follows:

1. Locate all longitudinal pipe insulation jacketing laps in least visible location.
2. Draw jacket tight and smooth.
3. For proper sealing, seal lap joints with reasonable pressure being applied with a plastic squeegee or sealing tool.
4. Vapor seal all circumferential joints with factory furnished matching pressure sensitive butt strips installed with reasonable pressure being applied with a plastic squeegee or sealing tool

N. Install insulation with non-self-sealing factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive selfsealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

O. Cut and install insulation in a manner to avoid compressing insulation more than 25 percent of its original nominal thickness.

P. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

Q. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

R. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.
7. Unions.
8. Flanges.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

F. Insulation Installation at Floor Penetrations:

1. Install insulation continuously through floor penetrations.

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Secure insulation with anchor pins and speed washers. Insulation for tanks and vessels should only be applied using weld pins or self-adhesive pins (depending on the circumstances) and speed washers. Adhesive should not be used to secure insulation to the tanks or vessels except when utilizing flexible elastomeric insulation.

1. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
2. Protect exposed corners with secured corner angles.
3. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.

d. Do not overcompress insulation during installation.
e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
f. Impale insulation over anchor pins and attach speed washers.
g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
5. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
6. Stagger joints between insulation layers at least 3 inches.
7. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
8. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
9. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. PIPE & TANK INSULATION AND KWIKFLEX

1. Apply on clean, dry surfaces
2. Cut to appropriate length using manufacturers' stretch out guide for the specific pipe size. Add an additional 2 inches to 4 inches for staple flap.
3. Install insulation around the equipment and pipe circumference in a manner that ensures a firm fiber mesh at all joints. Fasten the longitudinal with outward clinches staples placed 3 inches on center. As an alternative, individual sections may be fastened in lace using continuous and overlapping strands of ¾" wide glass fiber filament tape around the insulation jacketing O.D. Longitudinal and circumferential joints shall be sealed with 4" wide matching pressure sensitive tape squeegeed along the entire length.
4. For equipment and pipe exposed to the elements, jacketing shall be or 0.016 inches thick aluminum with factory applied moisture barrier 0.010 inches thick stainless steel with a factory applied moisture barrier or laminated self-adhesive water and weather seals. Fitting covers shall be similar materials. The insulation and jacketing shall be held firmly in place with a friction type Z lock or a minimum 2" overlap joint. For systems operating below ambient, all joints shall be sealed completely along the longitudinal and circumferential seams and installed so as to shed water. All circumferential joints shall be sealed by use of preformed butt strips; minimum 2" wide or a minimum 2" overlap. Butt strips shall overlap the adjacent jacketing a minimum ½ inch and be completely weather sealed. For systems operating above ambient, circumferential joints should overlap a minimum of 2" and not be sealed. Insulation thickness for duct covered by Jacketing shall be such that the surface temperature of the does not exceed 125°F.
5. On below ambient straight duct, vapor retarder mastic shall be applied to raw glass fiber ends at 12 foot to 21 foot intervals, and on either side of fittings, flanges or valves before taping. Mastic shall extend a minimum of 2 inches onto the bore of the pipe and 2 inches onto the jacketing.

C. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

D. Insulation Installation on Pumps:

1. Fabricate removable, re-useable metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Covers for split case pumps shall be constructed with insulated housing in two sections with upper section removable for access to casing. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from aluminum or stainless steel, at least 0.050 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.6 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Fittings shall be insulated to same thickness as the adjoining insulation. Apply fittings per fitting manufacturer's instructions. When required by specification, a hard insert of sufficient length shall be utilized to avoid compression of the insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 GLASS MINERAL WOOL INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes.

1. Secure pipe insulation to pope using self-sealing lap system.
2. On high temperature piping, above 500°F, apply insulation using double layer and staggered joints. For double layer installation, secure the unjacketed inner layer using filament tape; without deforming insulation material. All joints and ends must be firmly butted and secured with appropriate securing material.
3. Firmly rub all longitudinal and circumferential joints using a squeegee or sealing tool.
4. Longitudinal jacket laps for pope insulation installed on piping systems with operating temperatures below ambient shall be vapor sealed with factory-applied pressure-sensitive adhesive vapor retarder, self-sealing lap. For proper sealing, firmly rub lap joints with reasonable pressure being applied with a plastic squeegee or sealing tool. Vapor seal all circumferential joints with factory-furnished, matching pressure-sensitive butt strips installed with reasonable pressure being applied with a plastic squeegee or

sealing tool. Additionally, coat raw edges of pipe insulation sections with vapor retarder mastic at 12 foot to 21 foot intervals, and on either side of all fittings, flanges, or valves. Vapor retarder mastic shall completely coat the ends of the pipe and extend onto the bore of the pope insulation and onto the jacketing a minimum of 2 inches. Follow NAIMA's "Guide to Insulating Chilled Water Piping Systems with Mineral Fiber Pipe Insulation" for additional details.

5. Install metal shields between hangers or supports and the pope insulation. Install rigid insulation inserts as required between the pope and the insulation shields. Inserts shall be of equal thickness to the adjacent insulation and shall be vapor sealed as required. Insulation shields shall be no less than the following lengths:

    a. 1 – 1/2 inch to 2- 1/2 inch IPS: 10 inch long.
    b. 3 inch to 6 inch IPS: 12 inch long

6. For piping subject to abuse in mechanical rooms or high traffic areas, protect insulation from mechanical abuse by the use of appropriate thickness of PVC jacketing, metal jacketing, or laminated self-adhesive water and weather seal.
7. For piping exposed to the elements, install Redi-Klad Insulation with 4 inch butt stripes and self-sealing lap, a jacket that shall be a minimum of 0.016 inch thick aluminum jacket with factory-applied moisture barrier or a minimum 0.010 inch thick stainless steel jacket with factory-applied moisture barrier. Fittings shall be of similar materials. Apply all jacketing per manufacturer's recommendations for the conditions.
8. For piping operating below ambient temperature or in high abuse areas, install Redi-Klad Pipe Insulation with 4 inch butt strips and self-sealing lap. Follow the same guide lines with using Redi0Klad as indicated for ASJ+-SSL+above.

B. Insulation installation for pipe flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with Glass Mineral Wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed formaldehyde free Glass Mineral Wool fittings; minimum 50 percent recycled glass content, of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed formaldehyde free fittings; minimum 50 percent recycled glass content, of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 CELLULAR-GLASS INSULATION INSTALLATION

A. A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellularglass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer’s recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer’s written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with tape or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.9 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.10 ROCK MINERAL WOOL INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials, unless jacketing with self-sealing laps are used.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with tape or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.11 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer’s recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer’s recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

1. Where rubber membrane jackets are indicated, install the membrane using the manufacturer’s recommended adhesive. Before use thoroughly stir the adhesive. Replace the container lid when work is interrupted. If required thin the adhesive as recommended by the manufacturer.
2. Using a sheepskin or similar roller apply a primer coat of adhesive to the roof surface, priming only the area of roof where the membrane will be laid the same day. Allow adhesive to dry.
3. Unroll the membrane and fold back approximately half its length.
4. Apply adhesive with a sheepskin or similar roller to the underside of the membrane ensuring the weld area is kept free of adhesive and allow to touch dry.
5. Carefully roll out the membrane over the previously primed surface and roll with water filled roller.
6. Fold back other half of the roll of membrane and repeat the procedure.

7. Unroll the next roll of membrane, ensuring the end laps are staggered and the side overlaps the previously installed sheet by 2 inches.
8. Repeat the adhering process.
9. Fully hot air weld the 2-inch side lap, allow to cool completely.
10. Mechanically check the integrity of the cooled weld by running a 3/16-inch wide screwdriver (with rounded edges) along the seam applying pressure into the seam.
11. Install Peel Stop and PVC Welding Cord at all perimeters, penetrations and changes of roof direction.

E. Pipe Sound Lagging:

1. Seal and fasten in accordance with manufacturer's written instructions to maintain specified STC rating.
2. Cover entire pipe with glass fiber wrap. Fill all voids with clean glass fiber scrap. Apply over this wrap an airtight cover of loaded vinyl. Do not connect the cover rigidly to pipe or hangers. Overlap longitudinal seams in loaded vinyl 2-inch minimum and tape with cloth-backed tape. Overlap edge seams 1-inch minimum and tape with cloth-backed tape or with acoustical sealant. Extend ends of cover within 1/2-inch of penetration through wall, ceiling, and/or floor. Seal annular gap between pipe lagging and penetration airtight with acoustic sealant.

3.12 FINISHES

A. Finish Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Refer to Division 09 painting Sections.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

E. Clad-type weather-resistant jacket such as Venture clad may be used to finish plumbing equipment exposed to weather.

F. Piping exposed to weather Knauf Earthwool Redi-Klad 1000 Pipe Insulation with Ecose® Technology may be utilized as long as it is installed per the manufacturer's installation procedures.

3.13 INSULATION APPLICATION SCHEDULE

A. Acceptable insulation materials, thickness and vapor retarder requirements are identified for each application and size range. If more than one material is listed for an application and size range, selection from the materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Fire-suppression piping.
2. Drainage piping located in crawl spaces.

3. Below-grade piping.
4. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.14 PLUMBING PIPING INSULATION APPLICATION SCHEDULE:

A. Unconditioned spaces include locations where summer temperature and humidity conditions are similar to outdoor conditions (such as mechanical rooms ventilated with unconditioned outdoor air, etc.) Pipes in these spaces to be insulated similar to outdoor requirements.

B. Where rigid pipe insulation (cellular glass, etc.) is scheduled, provide mineral fiber through and 6 inches beyond pipe sleeves, to allow for pipe expansion.

SERVICE	INSULATION MATERIAL	VAPOR RETARDER REQUIRED	PIPE SIZE	INSULATION THICKNESS REQUIRED
Domestic cold water, potable (Indoor)	Glass Mineral Wool	Yes	<8”	1”
Domestic hot water and hot water recirculating, potable and non-potable (Indoor)	Glass Mineral Wool	No	<1.5”	1”
			≥ 1.5”	1.5”
Storm Water	Glass Mineral Wool	Yes	All	1”
Storm water roof drain bodies	Mineral Fiber Blanket	Yes	All	1”
Air conditioning condensate drain, and equipment drain	Flexible Elastomeric	No	<1”	0.5”
			1” to <8”	1”
Above floor: floor drains, traps, and drain piping receiving condensate and equipment drain water. Hot and cold service	Glass Mineral Wool	Yes	All	1.5”

Exposed sanitary drains and domestic water supplies and stops for fixtures	TruBro LAV-guard-2	Yes	All	Per Specification
Exposed piping, electronic faucet connections, mixing valves, trap primers and hot water heaters	Truebro Lav Shield	Yes	All	Per Specification

3.15 PLUMBING EQUIPMENT INSULATION APPLICATION SCHEDULE

SERVICE	INSULATION MATERIAL	INSULATION THICKNESS	VAPOR RETARDER REQUIRED
DOMESTIC HOT WATER PUMP	Glass Mineral Wool	1”	No
EXPANSION TANKS (FOR DOMESTIC HOT WATER DUTY	Glass Mineral Wool Board; or Glass Mineral Wool Pipe and Tank	1”	No
DOMESTIC HOT WATER STORAGE TANKS	Glass Mineral Wool Board; or Glass Mineral Wool Pipe and Tank	4”	No

3.16 FIELD APPLIED JACKET APPLICATION SCHEDULE

SERVICE	FIELD APPLIED JACKET TYPE
Indoor, exposed insulated piping within 12 feet of floor, for service temperatures 200 degrees F and below.	PVC or Earthwool Redi-Klad
Indoor, exposed insulated piping greater than 12 feet above floor, generally.	None
Indoor, cold service piping (domestic cold water) greater than 12 feet above the floor, within spaces subject to outdoor temperature and humidity conditions (such as mechanical and electrical rooms ventilated with unconditioned outdoor air, etc.)	PVC or Earthwool Redi-Klad
Indoor concealed piping	None
Outdoor exposed piping	Aluminum
Indoor, All Locations, Fittings and valves in piping systems at service temperatures 200 degrees F and below.	Factory Fabricated PVC covers
Outdoor underground insulated piping	Underground Direct Buried Jacket
Piping in sound sensitive areas (as indicted on the drawings)	Pipe Sound Lagging (Note 3)
Equipment, generally (Refer to Notes 1 & 2)	Woven Glass Fiber Fabric
Equipment, cold surface (Refer to Notes 1 & 2)	PVC or Self-Adhesive Outdoor Jacket

A. Jacket Application Schedule Notes:

1. Refer to Part 3 specification section titled “Equipment, Tank, and Vessel Insulation Installation” for requirements for removable, re-usable metal boxes lined with insulation at pumps.
2. Including factory insulated equipment without factory applied jacket.
3. If ductwork or piping indicated to have sound lagging also requires an additional field jacket, install sound lagging between insulation and additional field jacket.

END OF SECTION

SECTION 22 08 00
COMMISSIONING OF PLUMBING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes commissioning process requirements for Plumbing systems, assemblies, and equipment.

B. Commissioning requires the participation of Division 22 to ensure that all systems are operating in a manner consistent with the Contract Documents.

C. The contractor shall execute all commissioning responsibilities assigned to them described in Section 01 75 00 "General Commissioning Requirements", the Contract Documents, and in the Commissioning Plan issued by the CxA.

1.02 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.03 INFORMATIONAL SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

1.04 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meeting.

C. Participate in orientation and inspection for Plumbing systems, assemblies, equipment, and component maintenance as directed by the CxA.

D. Provide approved submittals and information requested by the CxA for final commissioning documentation.

E. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.05 CXA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual Plumbing systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Provide test data, inspection reports, and certificates in Systems Manual.

1.06 COMMISSIONING DOCUMENTATION

A. Contractor to provide the following information to the CxA for inclusion in the commissioning plan:
   1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
   2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
   3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for Plumbing systems, assemblies, equipment, and components to

be verified and tested.

4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that Plumbing systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 TESTING PREPARATION

A. Certify that Plumbing systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that Plumbing instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

D. Inspect and verify the position of each device and interlock identified on checklists.

E. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

F. Testing Instrumentation: Provide and install measuring instruments and logging devices to record test data as directed by the CxA.

3.02 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of Plumbing testing shall include entire Plumbing installation. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The CxA along with the Plumbing Contractor shall prepare detailed testing plans, procedures, and checklists for Plumbing systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the Plumbing system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.03 PLUMBING SYSTEMS AND EQUIPMENT TESTING PROCEDURES

A. Provide submittals, test data, inspector record, and boiler certification to the CxA.

B. Plumbing Instrumentation and Control System Testing: Perform field testing following testing plans and requirements. Assist the CxA with preparation of testing plans.

C. Plumbing Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of domestic hot water distribution systems.

3.04 SYSTEMS TO BE COMMISSIONED

A. Plumbing contractor should understand that the commissioning shall consist of all equipment related to the creation and distribution of the domestic hot water system.

22 XX XX	**ELECTRIC DOMESTIC WATER HEATERS**	**100%**

END OF SECTION

SECTION 22 10 00
PLUMBING PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specifications, apply to this section, and the other sections of Division 22.

1.2 SUMMARY

A. Section includes:

1. Elevator oil minder sump pumps system.
2. In-line domestic hot water circulation pumps (ECM motor).
3. Duplex submersible sump pump.
4. Air conditioning condensate pumps (non-plenum rated).
5. Air conditioning condensate pumps (plenum rated).

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 22 Section: “Common Motor Requirements”: Product requirements for motors for placement by this section.
2. Division 22 Section: “Vibration and Seismic Controls for Plumbing Piping and Equipment”: Product requirements for vibrations isolators installed with pumps.
3. Division 22 Section: “Pipes and Tubes for Plumbing Piping and Equipment”: Execution requirements for connection to pumps specified by this section.
4. Division 22 Section: “General-Duty Valves for Plumbing Piping”: Product requirements for valves used in hydronic piping systems.
5. Division 26 Section: “Low Voltage Electrical Power Conductors & Cables”: Requirements for electrical wiring and cable connections to pumps specified by this section.
6. Division 26 Section: “Raceways and Boxes for Electrical Systems:” Requirements of conduits and boxes housing electrical wiring and electric connections for pumps specified in this section.”

1.3 REFERENCES

(“Unless otherwise noted, references apply to “latest” “editions”)

A. National Electrical Manufacturers Association:

1. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).

B. Underwriters Laboratories, Inc.:

1. UL 778 – Motor Operated Water Pumps.

C. American National Standards Institute:

1. NSF/ANSI 372 – Drinking Water Systems Components – Lead Content.
2. NSF/ANSI 61 & Annex G – Drinking Water Systems Components - Health Effects.

D. American Society of Heating, Refrigeration and air Conditioning Engineers:

1. ASHRAE 90.1 – 2010 – Energy Standard for Buildings, Except Low-Rise Residential Buildings.

1.4 DEFINITIONS

A. Lead Free:

1. Circulator pumps shall be “lead free”, containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.
2. The pipes, pipe fittings, plumbing fittings or fixtures in plumbing systems that are intended to dispense potable water for human consumption, including drinking and cooking, shall be “lead free”, containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.
3. Solder and flux for soldered joints in potable water piping shall be “lead free”, containing not more than 0.2% lead free.

1.5 SUBMITTALS

A. Division 01 Section – “Submittal Procedures”: Requirements for submittals.

B. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.

C. Plumbing drainage specialties: Submit manufacturers catalog information with sizes, capacities, rough-in requirements, service sizes, and finishes.

D. Plumbing supply specialties: Submit manufacturers catalog information with sizes, capacities, rough-in requirements, service sizes, and finishes.

E. Pumps: Include capacities, pump curves, equipment performance, and electrical characteristics.

F. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

H. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.6 CLOSEOUT SUBMITTALS

A. Division 01 Section – “Execution and Closeout Requirements”: Requirements for Submittals.

B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with all applicable codes, standards, and local authorities having jurisdiction requirements.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products in this section with minimum three years documented experience.

1. Manufacturer shall be listed by UL as a manufacturer of packaged pumping systems under UL/CUL category QCZJ and pump package shall bear labeling noting this.

B. Installer: Company specializing in performing work of this section with minimum three years experience and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section – “Product Requirements”: Requirements for transporting, handling, storing and protecting products.

B. Prepare pumps and accessories for shipment to prevent entry of foreign matter into product body.

C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on the ground; handle products to prevent damage to interior or exterior surfaces.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

A. Division 01 Section – “Execution and Closeout Requirements”: Product warranties.

B. Furnish five year manufacturer’s warranty for pumps.

1.12 DEFINITIONS

A. Lead Free:

1. The pipes, pipe fittings, plumbing fittings or fixtures in plumbing systems that are intended to dispense potable water for human consumption, including drinking and cooking, shall be “lead free”, containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.
2. Solder and flux for soldered joints in potable water piping shall be “lead free”, containing not more than 0.2% lead free.

PART 2 - PRODUCTS

2.1 ELEVATOR OIL MINDER DUPLEX PUMP SYSTEM

A. Manufacturer:

1. Pumps shall meet model numbers, types, sizes, capacities, and electrical characteristics as indicated on the contract drawings. Acceptable manufacturers: Stancor, Zoeller, B&G, or federal Pump Company.

B. General:

1. Sump pump and control shall allow water to be automatically pumped from a sump basin without danger of ejecting potentially harmful oily substances into sewers or drainage system.
2. System shall include one (1) control panel, and junction box.
3. The system shall function automatically and shall provide for an alarm and separate LED lights in the event of the presence of oil in the sump, high liquid in the sump or, high amps or a locked rotor condition. In addition LED lights shall be provided for (1) power and (2) pump run function.
4. An alarm shall sound in the event of a high liquid condition.
5. The Pump, Control Panel, Junction Box, Float and Sensor Probe shall be ENTELA tested, Certified and Approved by the local governing jurisdiction.
6. Include cover, valves, piping and GFI duplex 115V/1ϕ/60HZ convenience outlet and any other required items as necessary to provide a completely functional installation.

C. Pump Basin & Cover:

1. The pump basin shall be constructed of concrete; 24”x24”x24” deep. Provide with a 24”x24” perforated steel cover.

D. Submersible Sump Pump:

1. The pump shall be approved at UL 778 standards and shall include thermal and overload protection.
2. The motor shall be rated ½ HP, 1 phase, 115 volt and capable of operating continuously or intermittently.
3. The motor housing shall be constructed of #304 stainless steel and mechanical seals shall be housed in a separate oil-filled chamber.

E. Mechanical Seal/Impeller:

1. A double mechanical seal system shall be furnished. The entire double mechanical seal assembly shall be housed in a seal chamber filled with clean dielectric oil. Impeller shall be of cast iron construction.

F. Control Panel:

1. The main control shall be approved to UL 508 standards and housed in a gasketed NEMA 4X enclosure with a see-through window for observation of operating functions.
2. The control shall be equipped with an 8-pin twist lock receptacle, dual solid state Oil-Minder relays with variable sensitivity settings, an over current relay, self cleaning stainless steel sensor probe, high decibel warning horn with alarm silencing switch, dual floats, clearly marked terminal board and remote monitoring contact.
3. A NEMA 4X junction box with 8-pin twist-lock electrical receptacle and 25’ of mating 8 conductor cable. All cables between the pump and junction box shall be 16’ long and the cable and plug from the control unit shall be 8’ long.
4. The control unit, junction box, pump, floats and sensor probe shall be factory assembled as a complete, ready to use system.
5. The system shall allow for the main control to be located outside of the elevator hoist way to be monitored for all functions without having to enter the elevator shaft.
6. Provide Mechanical Float Switches, one for Normal On-Off operation and one for High Water Alarm, with 16’ Cables.

2.2 IN-LINE DOMESTIC HOT WATER CIRCULATION PUMPS (ECM MOTOR)

A. The circulator pumps, shall be “lead free”, containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.

B. Pumps shall meet model numbers, types, sizes, capacities and characteristics as scheduled on the equipment schedule drawings acceptable manufacturers: Bell & Gossett, Taco, Grundfos, Aurora, or Wilo.

1. Basis of design is Ecocirc XL as manufactured by Bell & Gossett.

C. The pumps shall be of the high efficiency type specifically designed for quiet operation.

D. The pumps shall be a wet rotor inline pump, in cast iron or lead free bronze body construction specifically designed for quiet operation. Suitable standard operations at 230° F and 175 PSIG working pressure. The pump internals shall be capable of being serviced without disturbing piping connections.

E. The pump internals shall be capable of being serviced without disturbing piping connections.

F. Pump shall be equipped with a water-tight seal to prevent leakage.

G. Pump volute shall be of a cast iron design for heating systems or lead free bronze or stainless steel for domestic water systems. The connection style on the cast iron and bronze pumps shall be flanged.

H. Flange to Flange dimension shall be standard Bell & Gossett booster sizes such as 6-3/8”, 8-1/2”, 11-1/2”, and 12”. Flange dimensions shall be HVAC industry standard 2 or 4 bolts sizes.

I. Motor shall be a synchronous, permanent-magnet (PM) motor and tested with the pump as one unit. Conventional induction motors will not be acceptable.

J. Each motor shall have an Integrated Variable Frequency Drive tested as one unit by the manufacturer.

K. Integrated motor protection shall be verified by UL to protect the pump against over/under voltage, over temperature of motor and/or electronics, over current, locked rotor and dry run (no load condition).

L. Pump shall have MODBUS or BACnet connections built into the VFD as standard options.

M. Analog inputs, such as 0-10V and 4-20mA, are standard inputs built into the VFD.

N. Pumps shall be UL 778 listed and bear the UL Listed Mark for USA and Canada with on-board thermal overload protection.

O. Pumps shall be UL 778 listed and bear the UL Listing Mark for USA and Canada with on-board thermal overload protection.

P. Each pump shall be factory performance tested before shipment.

Q. OPERATING MODES

1. Proportional Pressure – The differential pressure will continuously increase or decrease along a linear curve based on the flow demand.
2. Constant Pressure – The pump maintains a constant differential pressure set by the user at any flow demand until the maximum speed is reached.
3. Constant Speed – The pump maintains a constant speed at any flow rate
4. Night Set Back – The pump will recognize a 10°C water temperature reduction and will switch to nighttime operation.
5. T-Constant – This control will use a PI algorithm to vary the speed of the pump in order to maintain a constant temperature of the fluid media.
6. Delta-T Constant – This control mode will use a PI algorithm to vary the speed of the pump in order to maintain a constant differential temperature between the built-in temperature sensor and external temperature sensor.
7. Delta-P-T – This control mode is paired with proportional or constant pressure mode. The nominal differential pressure setpoint will vary according to the fluid temperature.
8. Delta-P-Delta-T – This control mode is paired with proportional or constant pressure mode. The nominal differential pressure setpoint will vary according to the differential temperature between the built-in temperature sensor and external temperature sensor.

2.3 DUPLEX SUBMERSIBLE SUMP PUMP

A. Manufacturer:

1. Pumps shall meet model numbers, types, sizes, capacities, and characteristics as scheduled on the Equipment Schedule Drawings. Acceptable manufacturers: Weil, B&G, Flowserve, Aurora, or Tsurmi.

B. General:

1. System shall include two (2) wastewater pumps with quick removal fittings, stainless steel guide rails, discharge elbows and bottom guide rail supports, steel main cover with pump access covers and top guide rail supports.
2. Provide a NEMA 3R steel control panel for remote mounting.
3. All to be assembled in a fiberglass basin to include all necessary discharge piping, valves and fittings.

C. Pump, Basin, & Cover:

1. The pump basin shall be constructed of fiberglass, **<<___“>>** diameter x **<<__“>>** deep. The steel cover shall be bolted to the top flange of the basin.
2. Pump mounting base shall be bolted to the steel anti-floatation plate that is embedded in the bottom of the fiberglass basin.
3. The discharge piping from the pumps shall be 2” with 2” gate and weight and lever swing check valves, all connected to common 2” discharge pipe.

D. Submersible Sump Pump:

1. Pump casing, impeller and discharge elbow shall be manufactured from heavy-duty, close grain, high-density cast iron.

E. Motors:

1. The pump motors shall be NEMA 6 Submersible, Design Type B equivalent.
2. The pump motors shall be of an air filled design. Oil filled motor shells shall not be considered equal.
3. Motor end bell shall be designed as a terminal box and separated from the motor shell by combination bearing support and inspection plate.
4. Motors shall be housed in a watertight cast iron shell with extended cooling fins and shall have class “F” insulation and permanently lubricated double seal ball bearings that have a rated life of 17,500 hours. Motors using sleeve type bearing shall not be considered equal.
5. The mating surfaces between the motor end bell, motor shell, and seal housing shall be sealed by means of “X” cross section quad rings.
6. Motor shaft shall be stainless steel with keyway for positive positioning of impeller.
7. Carbon steel shafts shall not be considered equal. Each motor shall be furnished with 25 feet of neoprene jacketed power cable.

F. Mechanical Seal:

1. A double mechanical seal system shall be furnished. The entire double mechanical seal assembly shall be housed in an oil seal chamber filled with clean dielectric oil. Seal surfaces shall be of solid silicon carbide. Carbon ceramic, tungsten carbide, or systems that allow the lower seal mechanism to come in contact with the pumped media shall not be considered equal.

G. Impeller:

1. The impeller shall be non-clog type and shall be made of close grain cast iron, accurately machined to the proper diameter. All impellers are to be statically and dynamically balanced.

H. Quick Removal System:

1. Units shall be furnished with a sliding guide rail so that the motor and pump end can be raised and lowered in the pit without un-bolting or disturbing the discharge piping.
2. The pump elbows shall be a heavy duty four bolt pattern and provided by the pump manufacturer and shipped with 20 feet of stainless steel lifting cable.

I. Control Panel:

1. Control shall be from a duplex control panel. Panel shall be a NEMA 3R steel enclosure. Panel shall be wall mounted. The following items shall be standard:

(2) Fused disconnect switches with lockout handles thru cover for main sewage pumps

(2) Magnetic starters with overload and low voltage protection

(2) Hand-Off-Automatic selector switches

(1) Electric alternator and PLC

(2) Control circuit transformers, 120 volt

(2) Pump running lights

(2) Overload reset buttons

(1) Wired and numbered terminal strip

(1) High water alarm with light, alarm buzzer and silencing switch with dry contacts for remote monitoring

(4) Mercury float switches

2.4 AIR CONDITIONING CONDENSATE PUMP (NON-PLENUM RATED)

A. Manufacturer:

1. Pumps shall meet model numbers, types, sizes, capacities, and characteristics as scheduled on the Equipment Schedule Drawings. Acceptable manufacturers: Little Giant, Bell & Gossett or Hartell.

B. Unit shall come with vertical type pump unit.

C. Motor shall come with stainless steel shaft, and thermal overload protection.

D. Pump shall be UL listed.

E. Unit shall come with:

1. ABS housing, ABS cover, and ABS volute.
2. Leakproof, rust proof, ABS tank, with mounting tabs.
3. 3/8” O.D. barbed discharge adapter.
4. 3 drain holes.
5. Built-in check valve.
6. 6’ long power chord.
7. 20’ shut-off head.

F. Provide unit with optional safety switch.

G. Impeller shall be glass filled polypropylene.

H. Pump shall be suitable for intermittent liquid temperatures up to 120°F and for high-efficiency gas furnace condensate as well as standard HVAC unit condensate.

2.5 AIR CONDITIONING CONDENSATE PUMPS (PLENUM RATED)

A. Manufacturer:

1. Pumps shall meet model numbers, sizes, capacities and characteristics as indicated on the contract drawings. Acceptable manufacturers: Hartell Model: A2-X-1965 or comparable acceptable product.

B. Pumps shall be UL 2043 Plenum Rated.

C. Pumps shall be Dual Voltage Commercial.

D. Pumps shall come with Heavy Duty Cast Aluminum Reservoir.

E. Pumps shall have Dual Voltage Thermally Protected Motor.

F. Pumps shall have Stainless Steel Motor Shafts.

G. Pump Voltages shall be as indicated on pump schedule on the contract drawings.

H. Inlet Diameter = 1-3/8 inches

I. Outlet Size = 3/8 inches

J. Outlet Connection Type = FNPT

K. Pumps shall come with hard wire leads only.

L. Provide each pump with an Auxiliary Switch.

M. Flow Rates

1. Flow Rate at Lift of 6’ 185 gal/h (3.08 GPM)
2. Flow Rate at Lift of 12’ 139 gal/h (2.31 GPM)
3. Flow Rate at Lift of 18’ 79 gal/h (1.31 GPM)
4. Flow Rate at Lift of 20’ 51 gal/h (.85 GPM)

N. Pump Reservoirs shall hold a minimum of 1 gallon.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section – “Administrative Requirements”: Verification of existing conditions before starting work.

B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 INSTALLATION - PUMPS

A. Install line size valving as indicated on the contract drawings on pump suctions and discharges.

B. Install pumps with shaft length allowing sump pumps to be located minimum 24 inches (600 mm) below lowest invert into sump pit and minimum 6 inches (150) clearance from bottom of sump pit.

C. Lubricate pumps before start-up.

D. All power and control wiring shall be performed per manufacturer’s instructions and applicable codes, standards and the authority having jurisdiction.

E. Install flexible connectors at or near pumps where piping configuration does not absorb vibration. Refer to Division 22 Section “Vibration and Seismic Controls for Plumbing Piping and Equipment”.

F. Third Party Testing, NSF, and OSHA Requirement:

1. The package shall be UL Listed as a system for its intended use, a NSF 61 approved system per NSF 61 guidelines so meeting OSHA Federal Regulations 29 CFR 1910.303 and 399 as well as NFPA Pamphlet #70 (National Electric Code) Article 90-7, City of Los Angeles Approval Code, CMR248 Massachusetts State Plumbing Code Approval.

G. Factory Test:

1. The package shall be electrically and hydrostatically tested before shipment, in addition, each system shall be factory tested from 0-100% of flow and pressure. Provide certified x-y test report.

H. Startup:

1. The factory authorized local representative shall provide (2) hours of startup and field training.

3.3 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section “Commissioning”.

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable

END OF SECTION

SECTION 22 25 01

PLUMBING PIPING SYSTEMS CLEANING AND TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Potable Water Systems

B. Related Sections: The following Sections contain requirements that relate to this Section

1. Division 23: “Common Motor Requirements”: Product requirements for motors for placement by this section.
2. Division 26: “Wiring Devices”: Execution requirements for electrical connection specified by this section.

1.3 DEFINITIONS

A. Point of Delivery is the outlet of the service meter assembly, or the outlet of the service regular (service shutoff valve when no meter is provided).

B. Domestic Water Systems: A system conveying domestic potable or non-potable water, such as Cold Water, Hot Water, Hot Water circulating, etc.

1.4 REFERENCES

A. Unless otherwise noted, references included throughout this specification section apply to “Latest Edition”.

1.5 SUBMITTALS

A. Division 01 Section – “Submittal Procedures”: Submittal Procedures.

B. Product data for each type of product specified. Include manufacturer's technical product data, rated capacities of selected equipment clearly indicated, water-pressure drops, weights (shipping,

installed, and operating), furnished specialties, accessories, and installation and startup instructions. Provide a list of all chemicals and quantities, including material safety data sheets.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

D. System diagram showing all piping, valving, tubing, treatment equipment, etc.

E. Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed wiring and field-installed wiring.

F. Field test reports indicating and interpreting test results relative to compliance with specified requirements.

G. Maintenance data for chemical water treatment to include in the operation and maintenance manual specified in Division 01. Include detailed manufacturer's instructions and parts list for each item of equipment, control, and accessory. Include troubleshooting maintenance guide.

H. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.6 QUALITY ASSURANCE

A. Qualifications: A recognized chemical water treatment supplier with documented experience. The supplier shall employ an experienced consultant, available at reasonable times during the course of the Work to consult with Contractor, Architect, and Owner about water treatment.

1. Provide a list of at least five (5) projects of similar size and type, which have been in operation for at least 5 years.
2. Supplier shall provide 24-hour emergency service, and shall be capable of being on-site within 4 hours notice.

B. Chemical Standards: Meet state and local pollution-control regulations.

C. Comply with NFPA 70, “National Electrical Code,” for components and installation.

D. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

E. Provide cleaning of the piping systems and submit a certificate of compliance with the specification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide sterilization service by one of the following:

1. Chemical Water Treatment Sterilization Service:

a. Arc Water Treatment Co.
b. Aqua-Chem, Inc.
c. Ecolab.
d. Nalco Chemical Co.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install temporary (for the purpose of sterilization) treatment equipment level and plumb, according to manufacturer's written instructions.

B. Electrical: Conform to applicable requirements of Division 26 Sections for connecting temporary electrical equipment.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Provide the services of a qualified independent testing agency to perform field quality control testing.

3.3 STERILIZATION OF DOMESTIC WATER SYSTEMS

A. Sterilization:

1. After final testing for leaks, all new potable water lines shall be thoroughly flushed by plumbing contractor to remove foreign material. Before placing the systems in service, contractor shall engage a qualified service organization, Arc Water Treatment Company of Maryland, Inc. or approved equal, to sterilize the new water lies in accordance with the following procedure:

a. Through a ¾” hose connection in the main entering the building pump in sufficient sodium hypochlorite to produce a free available chlorine residual of not less than 200 ppm. Plumbing contractor shall provide plumbing connections and power for pumping chlorine into the system.

2. Proceed upstream from the point of chlorine application opening all faucets and taps until chlorine is detected. Close faucets and taps when chlorine is evident.

3. When chlorinated water has been brought to every faucet and tap with a minimum concentration of 200 ppm chlorine, retain this water in the system for three (3) hours. CAUTION: Over-concentration of chlorine and more than three (3) hours o retention may result in damage to piping system. It is not necessary to retain chlorine in any system for twenty-four hours to achieve sterilization. AWWA states that 200 ppm chlorine for three hours is sufficient.
4. At the end of the retention period, no less than 100 ppm of chlorine shall be present at the extreme end of the system.
5. Proceed to open all faucets and taps and thoroughly flush all new lines until the chlorine residual in the water is less than 1.0 ppm.
6. Obtain representative water sample from the system for analysis by a recognized bacteriological laboratory.
7. If the sample tested for coliform organism is negative, a letter and laboratory report shall be submitted by the service organization to the contractor, certifying successful completion of the sterilization.
8. If any samples tested indicate the presence of coliform organisms, the entire sterilization procedure shall be repeated.

3.4 SYSTEM START-UP

A. Startup Services: Provide the services of a factory-authorized service representative to provide startup service and to demonstrate and train Owner's maintenance personnel as specified below.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Startup Procedures: During boiler system startup, operate boiler water treatment system (after charging with specified chemicals) to maintain required steady-state characteristics of feedwater.

3.5 DEMONSTRATION

A. Division 01 Section – “Execution and Closeout Requirements”: Requirements for demonstration and training.

B. Provide services of supplier's technical representative for half a day to instruct Owner's personnel in operation, maintenance, and testing procedures of boiler water treatment system.

C. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

D. Review data in the operation and maintenance manuals Division 01. Refer to Division 01 Section: "Execution and Closeout Requirements."

E. Schedule training with Owner, through the Architect, with at least 7 days' advance notice.

3.6 SIX MONTH FOLLOW-UP SERVICE

A. The contractor shall return to the project site under warranty phase in six months to flush / blow down all: domestic water service piping.

3.7 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section “Commissioning”.

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable

END OF SECTION

SECTION 22 33 00

ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section and all sections of Division 22.

1.2 SUMMARY

A. Section includes:

1. Commercial electric water heaters.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 03 Section – “Cast-in-Place Concrete”: Execution requirements for concrete housekeeping pads specified by this section.
2. Division 22 Section: “Plumbing Insulation” for applied insulation for domestic water heaters.
3. Division 22 Section: “Pipes and Tubes for Plumbing Piping and Equipment” connections to domestic water heaters.
4. Division 22 Section: “General Duty Valves for Plumbing Piping”
5. Division 26 Section: “Low Voltage Electric Conductors and Power Cables:” Requirements for electric wiring and cable connections for water heaters specified in this section.
6. Division 26 Section: “Raceways and Boxes for Electrical Systems: “Requirements for conduits and boxes housing electrical wiring and connections specified in this section.”

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest edition.”)

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. American Society of Mechanical Engineers:

1. ASME PTC 25 - Pressure Relief Devices.
2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

C. American National Standards Institute:

1. NSF/ANSI 61 & Annex G: Drinking Water Systems Components – Health Effects.
2. NSF/ANSI 372: Drinking Water Systems Components – Lead Content.

1.4 SUBMITTALS

A. Division 01 Section – “Submittal Procedures”: Submittal Procedures.

B. Shop Drawings: Indicate water heater(s) dimensions, size of taps, and performance data. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, taps, and drains.

C. Product Data: Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Submit electrical characteristics and connection locations.

D. Manufacturer's Installation Instructions: Submit mounting and support requirements.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

F. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

CLOSEOUT SUBMITTALS

G. Division 01 Section – “Execution and Closeout Requirements”: Closeout procedures.

H. Operation and Maintenance Data: Submit replacement part numbers and availability.

1.5 QUALITY ASSURANCE

A. Conform to ASME Section VIII for construction of water heaters..

B. Water Heater Performance Requirements: Equipment efficiency not less than prescribed by ASHRAE 90.1.

C. Perform work in accordance with all applicable codes, standards and local authorities jurisdiction requirements.

D. Lead Free:

1. The pipes, pipe fittings, plumbing fittings or fixtures in plumbing systems that are intended to dispense potable water for human consumption, including drinking and cooking, shall be “lead free”, containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.

E. Solder and flux for soldered joints in potable water piping shall be “lead free”, containing not more than 0.2% lead.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years experience and approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section – “Product Requirements”: Product storage and handling requirements.

B. Accept water heaters on site in original labeled cartons. Inspect for damage.

C. Protect tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Division 01 Section – “Execution and Closeout Requirements”: Product warranties and bonds.

B. Furnish five year manufacturer warranty for domestic water heaters and water storage tanks.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, STORAGE HEAT PUMP WATER HEATERS

A. COMMERCIAL, ELECTRIC, STORAGE HEAT PUMP WATER HEATERS

1. Heaters shall be Hubbell Heater Omni Series Model PBX or equals by Vaughn or Ace.

2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.

3. Approval Standard: ANSI, cETLus, NAECA, ASHRAE Standard 90.1, and ICC

4. Tank Construction: Steel with Seamless Hydrastone cement applied via centrifugal spinning process to guarantee uniform distribution of ½" thick cement over all interior surfaces, and a cement density of 0.20 lbs./cubic inch minimum in order to provide increased longevity and inhibit oxidized water ingress.

    a. Heater lining shall be suitable for 180F continuous stored water service.
    b. Tappings: Each heater tank shall be fitted with non-ferrous solid copper-silicon threaded connections for maximum corrosion resistance. Tank lining shall extend into tappings for complete outer shell coverage.
    c. Inlet and Discharge Tappings for heaters – ¾" FNPT.
    d. Tank shall be supplied with 3" CFC free polyurethane foam insulation as standard.
    e. Tank shall have a rust-free high impact composite jacket. Jacket base pan shall be dimpled for integral feet to keep heater out of any water accumulation
    f. Tank shall not require a sacrificial anode for long life due to tank lining. Tank shall be fitted with an ASME approved T&P relief valve.
    g. Safety controls shall include a manual reset high limit set at 190F and both visual and audible error indication.
    h. Tank Pressure Rating – Working Pressure -150 psig, Design Pressure – 300 psig
    i. Standard Warranty – Ten (10) Year Non-prorated.

5. Heaters shall incorporate an integral air-cooled heat pump to heat stored water from the surrounding air environment.

    a. Heat pump shall operate with a CFC Free refrigerant and be capable of extracting heat from surrounding air as low as 40F. Minimal COP shall be 2.6.
    b. Unit shall incorporate Incoloy sheathed back up electric elements for heat supplement as needed.
    c. Integral Unit HubbellConnect Lite controller shall offer 7 different operating modes for the heater with a digital interface for mode selection and tank temp indication. Thermostat range shall be up to 160F.
    d. A manual reset refrigerant Over Pressure Safety control shall be mounted and wired from the factory.
    e. Unit shall operate on 208-240/1/60 power supply or as indicated by scheduled model(s) on plans.
    f. Air inlet to heat pump section shall include a washable filter media to keep evaporator coil clean. Unit shall include a ¼" condensate drain for gravity disposal.

6. Factory Installed or Provided Tank Appurtenances:

    a. Brass Drain Valve ¾" with hose-end drain connection incorporated into cold water inlet with integral diffuser
    b. Insulation: A minimum 3" thick polyurethane CFC free foam which will exceed ANSI/ASHRAE/IESNA 90.1 standard for heat loss.
    c. Jacket – Rust and Corrosion Resistant Vertical Composite Outer Jacket
    d. Electrical Elements: Incoloy Sheathed Screw plug type with O-ring Gaskets arranged in multiples of three (3). Upper and Lower 3800w elements shall be wired for non-simultaneous operation.
    e. No Sacrificial Magnesium Replaceable Rod shall be required.
    f. Built-in Heat Trap on ¾" Inlet/Outlet Models only.

g. ASME/CSA Temperature & Pressure Relief Valve – 210F deg, 150 psig
h. Operating Control: Adjustable Surface Thermostat 110F to 170F degrees.
i. Safety Control: Surface Manual Reset High Temperature Limit Control or Immersion Manual Reset Temperature Limit Control where required depending on high recovery versus storage ratio – Factory set at 190F.
j. Electric Control Warranty – Six (6) Year

PART 3 - EXECUTION

3.1 INSTALLATION

A. Maintain manufacturer's recommended clearances around and over water heaters.

B. Install water heaters on 4” high concrete housekeeping pads, dimensions per contract drawings. Refer to Division 03 Section: “Cast-In-Place Concrete”.

C. Connect domestic hot water and domestic cold water piping to supply and return water heater connections.

D. Install valves and piping accessories in accordance with details as indicated on the contract documents. Refer to Division 22 Section: “Pipes and Tubes for Plumbing Piping and Equipment” and to Division 22 Section: “General Duty Valves for Plumbing Piping and Equipment”.

E. Install discharge piping from relief valves and drain valves to nearest floor drain.

F. Install water heater trim and accessories furnished loose for field mounting.

G. Install electrical devices furnished loose for field mounting.

H. Install control wiring between water heater control panel and field mounted control devices.

I. Install Work in accordance with all applicable codes, standards, and local authorities having jurisdiction requirements.

J. Provide die-electric connections when dissimilar metals are present.

3.2 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section “Commissioning”.

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable

END OF SECTION

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section, and the other sections of Division 22.

1.2 SUMMARY

A. Section Includes

1. Water closets.
2. Urinals.
3. Lavatories.
4. Counter Top Sink.
5. Kitchen Sinks.
6. Showers.
7. Mop Sink / Service Sinks.
8. Water Coolers.
9. Penal Fixtures.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 22 Section: “Common Work Results for Plumbing.”
2. Division 22 Section: “Pipes and Tubes for Plumbing Piping and Equipment”: Supply connections to plumbing fixtures.
3. Division 26 Section: “Low Voltage Electric Power Conductors and Cables”: Requirements for electrical wiring and cable connections for sensor valves and faucets specified in this section.
4. Division 26 Section: “Raceways and Boxes for Electrical Systems:” Requirements for conduits and boxes housing electrical wiring and connections for items specified in this section.”

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”)

A. American National Standards Institute:

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ANSI Z124.2 - Plastic Shower Units.
3. ANSI Z358.1 - Emergency Eyewash and Shower Equipment.
4. NSF/ANSI 61 & Annex G: Drinking Water Systems Components – Health Effects.
5. NSF/ANSI 372: Drinking Water Systems Components – Lead Content.

B. Air-Conditioning and Refrigeration Institute:

1. ARI 1010 - Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.

C. American Society of Mechanical Engineers:

1. ASME A112.6.1 - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use.
2. ASME A112.18.1 - Plumbing Fixture Fittings.
3. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures.
4. ASME A112.19.2M - Vitreous China Plumbing Fixtures.
5. ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
6. ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks and Urinals.

D. Drinking Water System Components – Lead Content:

1. NSF/ANSI 372

1.4 DEFINITIONS

A. Lead Free:

1. The pipes, pipe fittings, plumbing fittings or fixtures in plumbing systems that are intended to dispense potable water for human consumption, including drinking and cooking, shall be “lead free”, containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.
2. Solder and flux for soldered joints in potable water piping shall be “lead free”, containing not more than 0.2% lead free

1.5 SUBMITTALS

A. Division 01 Section – “Submittal Procedures”: Submittal Procedures.

B. Product Data: Submit catalog illustrations of fixtures, sizes, [rough-in dimensions,] utility sizes, trim, and finishes.

C. Manufacturer's Installation Instructions: Submit installation methods and procedures.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Water Efficiency Prerequisite 2: Indoor Water Use Reduction

1. For water closet and urinal, documentation indicating flush rate in gallons per flush (gpf).

   a. Urinals and Tank-type Water Closets: Include documentation indicating WaterSense Label. Exclude security plumbing fixtures.
2. For faucets, aerators, and showerheads, documentation indicating flow rate in gallons per minute (gpm).

   a. Showerheads and aerators: Include documentation indicating WaterSense Label.

F. MR Credit 2: Environmental Product Declarations

a. Plumbing fixtures, if available

2. MR Credit 4: Material Ingredients

a. Report: Plumbing fixtures, if available: Material Ingredient Report.

G. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.6 CLOSEOUT SUBMITTALS

A. Division 01 Section – “Execution and Closeout Requirements”: Closeout procedures.

B. Operation and Maintenance Data: Submit fixture, trim, exploded view and replacement parts lists.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with all applicable codes, standards, and local authorities having jurisdiction requirements.

B. Provide products requiring electrical connections listed and classified by Underwriters Laboratories Inc., and/or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

C. Provide plumbing fixture fittings in accordance with ASME A112.18.1 that prevent backflow from fixture into water distribution system.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 50 miles of Project.

B. Installer: Company specializing in performing Work of this section with minimum three years experience, approved by manufacturer and with service facilities within 50 miles of project.

1.9 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section – “Product Requirements”: Product storage and handling requirements.

B. Accept fixtures on site in factory packaging. Inspect for damage.

C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.11 WARRANTY

A. Division 01 Section – “Execution and Closeout Requirements”: Product warranties and product bonds.

B. Furnish two (2) year manufacturer warranty for plumbing fixtures.

1.12 EXTRA MATERIALS

A. Division 01 Section: “Execution and Closeout Requirements:” Spare parts and maintenance products.

B. Furnish two sets of: faucet washers’ flush valve service kits lavatory supply fittings, shower heads, and toilet seats.

1.13 DEFINITIONS

A. Lead Free:

1. The pipes, pipe fittings, plumbing fittings or fixtures in plumbing systems that are intended to dispense potable water for human consumption, including drinking and cooking, shall be “lead free”, containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.
2. Solder and flux for soldered joints in potable water piping shall be “lead free”, containing not more than 0.2% lead free

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

A. Water Conserving Plumbing Fixtures: Provide water usage not to exceed, or to improve upon the following baselines for water conservation.

1. Water Closets: 1.1 gallons per flush (gpf)

   a. Water Closets with tanks: WaterSense Labeled

2. Water Closets, Penal: 1.28 gallons per flush (gpf)

2. Urinals: 0.125 gallons per flush (gpf), WaterSense Labeled

3. Kitchen Sink Faucets: 1.5 gallons per minute (gpm) at 60 psi

4. Public Lavatory Sink Faucets: 0.35 gallons per minute (gpm) at 60 psi

5. Showerhead: 1.5 gallons per minute (gpm) at 80 psi, WaterSense Labeled

B. Furnish and install all fixtures and trim necessary to complete fixture installation. Provide approved stop valve, to match fittings, on both hot and cold water supplies to each fixture, all fixtures requiring hot and cold water shall have cold water faucets on right and hot water faucets on left. Exposed metal work shall be chrome plated red brass. Fixtures shall be white, unless otherwise specified. (Note: The “P” identification symbol with each fixture identified type shown on drawings.) Where fixtures tailpieces, traps and stop valves are not indicated, same shall be provided to suit fixture.

C. Unless otherwise specified, the specified fixtures are taken from the catalogue of Zurn for convenience only. Provide similar fixtures of American Standard, Crane, Eljer Company, Elkay, Kohler, Sloan or an acceptable comparable product.

D. Coordinate flush valve mounting heights for all water closets with the locations of grab bars; refer to Architectural Contract Drawings for exact grab bar locations.

E. Refer to Architectural Drawings for mounting heights of all fixtures.

F. All exposed bolts, screws, fasteners, etc. shall be vandal proof.

G. Utilize Sani-Sett setting compound for fixtures.

H. All plumbing materials, equipment and fixtures shall be new and of best grade, free of defects and complete with all required appurtenances and accessories.

I. Provide supports necessary to adequately and substantially hang and set fixtures. Supports shall be Zurn, Watts, Josam or J.R. Smith and shall be suitable for wall types and thicknesses and piping arrangements shown.

1. Wall mounted, urinal supports, Watts CA-321 plate type or Zurn Z1222m plate type with cast iron headers, box steel stanchions, block type cast iron feet with bearing plate.
2. Support for wall mounted, urinals, lavatories, sinks, water coolers, etc.:

    a. Where fixtures are supported from concrete or cinder block walls, install No. 10 USSG steel plate on the opposite side of the wall and bolt hangers or supports through plate. Where opposite side of wall is exposed to view, place bolts in core of blocks and fill core with cement.
    b. Were lavatories with wall hangers have been specified and fixtures are supported from metal stud frame partitions, fixture brackets or mounting lugs shall be through bolted to steel channel crosspieces not less than 1 ½” wide anchored to studs. Bolt heads shall be welded to channel web.
    c. Concealed arm type lavatory supports, Zurn Z1231, or Watts TCA-411 with cast iron headers, box steel stanchions, block type cast iron fee and header and chrome plated cast brass threaded escutcheons for slab type lavatories.
3. Wall mounted water closet chair carriers, Watts ISCA-101 series or Zurn Z-1203 Series for horizontal installation.

J. Plumbing fixtures shall be caulked at walls and floors with silicone caulking material of same color as fixture(s).

K. Locate countertop sinks and/or under counter sinks furnished under this Division. Furnish templates to the countertop fabricator for cutting of required holes.

L. For sinks and fixtures specified under other divisions or other contracts and not provided with faucets, tailpieces, traps, stop valves and supply tubes, provide necessary fittings and completely connect the sinks and fixtures.

M. Where sensor operated flush valves and faucets are specified hereinafter, furnish transformer(s) to serve the maximum recommended number of fixtures per the fixture manufacturer's recommendations. Each transformer shall be suitable for a 120v primary voltage. Wiring shall be installed under Division 26.

N. Hot and cold water connections to fixtures shall be provided with a stop valve, stop valves, flexible braided risers, etc. Stop valves shall be ¼ turn and brass type: ½ "nominal compression inlet x 3/8" O.D. compression outlet, ¼ turn angle valve, 1 piece body construction, chrome plated, compatible with copper, cross-linked polyethylene, temperature rating: 40°F to 140°F, pressure rating: 125 PSI, no lead certified, IAPMO and CSA listed to ASME A 112.18.1/CSA B 125.1 as manufactured by Brasscraft Mfg. Co: Model: G2CR19 or an acceptable comparable product as manufactured by Chicago Faucet, or McGuire.

O. Refer to specification section "Pipes and Tubes for Plumbing Piping and Equipment", for tempered water public hand washing, and shower mixing valve requirements. All public hand washing fixtures to be provided with ASSE 1070 Mixing Valve. All shower fixtures to be provided with ASSE 1016 Mixing Valve.

P. Refer to plumbing fixture schedule for all required fixtures and all requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section: "Administrative Requirements": Coordination and project conditions.

B. Verify walls and floor finishes are prepared and ready for installation of fixtures.

C. Verify electric power is available and of correct characteristics.

D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

A. Install Work in accordance with all applicable codes, standards, and local authorities having jurisdiction requirements.

B. Install each fixture with trap, easily removable for servicing and cleaning.

C. Provide chrome plated flexible braided supplies to fixtures with ¼ turn handle stops, loose key reducers, and escutcheons.

D. Install components level and plumb.

E. Install and secure fixtures in place with wall supports or wall carriers and bolts as recommended by fixture manufacturer.

F. Seal joints between fixtures and walls, floors and counters using sanitary type one part mildew resistant sealant. Color to match fixture.

G. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

H. For ADA accessible water closets, install flush valve with handle to wide side of stall.

I. Provide fire rated plumbing enclosures at locations where valves, including shower valves, are installed in rated walls.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.5 ADJUSTING

A. Division 01 Section: “Execution and Closeout Requirements”: Testing, adjusting, and balancing requirements.

B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

A. Division 01 Section: “Execution and Closeout Requirements”: Final cleaning requirements.

B. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Division 01 Section: “Execution and Closeout Requirements”: Protecting installed construction.

B. Do not permit use of fixtures before final acceptance.

3.8 SCHEDULES

A. Refer to contract drawings for plumbing fixture schedule.

B. Fixture Rough-in: Refer to plumbing fixture schedule on contract drawings

3.9 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section “Commissioning”.

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable

END OF SECTION

SECTION 23 05 00
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 23.

1.2 SUMMARY

A. Section includes:

1. General administrative and procedural requirements, as well as the following basic mechanical materials and methods.
2. Submittals.
3. Coordination drawings.
4. Record documents.
5. Operation and Maintenance manuals.
6. Rough-ins.
7. Mechanical installations.
8. Cutting and patching.
9. Concrete equipment base construction requirements.
10. Equipment nameplate data requirement.
11. Labeling and identifying mechanical systems and equipment is specified in Division 23 Section: “Identification for HVAC Piping and Equipment.”
12. Non-shrink grout for equipment installations.
13. Field-fabricated metal and wood equipment supports.
14. Installation requirements common to equipment specification Sections.
15. Mechanical demolition.
16. Touchup painting and finishing.

1.3 ACRONYMS

A. The following list of abbreviations are utilized within the specifications and are provided as a reference:

1. AABC - Associated Air Balance Council
2. ADA - American Disability Act
3. ADC - Air Diffusion Council
4. AGA - American Gas Association
5. AMCA - Air Moving and Conditioning Association
6. ANSI - American National Standards Institute
7. ARI - Air Conditioning and Refrigeration Institute
8. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
9. ASME - American Society of Mechanical Engineers
10. ASTM - American Society for Testing and Materials

11. AWS - American Welding Society
12. AWWA - American Water Works Association
13. IBC - International Building Code
14. CS - Commercial Standard
15. CSA - Canadian Standards Association
16. IEEE - Institute of Electrical and Electronics Engineers
17. IMC - International Mechanical Code
18. IPC - International Plumbing Code
19. MOSHA - Maryland Occupational Safety and Health Administration
20. MSSP - Manufacturers Standards Society of the Valve and Fittings Industry
21. NEC - National Electrical Code
22. NEMA - National Electrical Manufacturers Association
23. NFPA - National Fire Protection Association
24. OSHA - Occupational Safety and Health Administration
25. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
26. TEMA - Tubular Exchanger Manufacturers Association
27. UL - Underwriters' Laboratories

1.4 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term product includes the terms material, equipment, system, and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Substitutions: Changes proposed by Contractor in products, materials, equipment, and methods of construction required by the Contract Documents.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named, or a product is accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

E. Extended Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.5 SYSTEM DESCRIPTION

A. Design Requirements: Contract drawings are generally diagrammatic and do not indicate all offsets, fittings, transitions, access panels and other specialties required.

1. Furnish and install all items as may be required at no additional cost to fit the work to the conditions encountered.
2. Arrange piping, ductwork, equipment and other work generally as shown on the contract drawings, providing proper clearances and access.
3. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawing submittal for approval in accordance with Submittals specified below.
4. Subject to the provisions of Division 01, Architect may make reasonable changes in location of equipment piping and ductwork up to the time of rough-in or fabrication.

1.6 SUBMITTALS

A. Comply with Division 01 Section: "Submittal Procedures".

B. Shop Drawings and Product Data:

1. Clearly identify all submittals:

a. Indicate intended application, location, etc.
b. Each submittal shall indicate the associated specification section, and paragraphs. Do not combine product data and shop drawing submittals from different spec sections into a single submittal package, even though they may be the same distributor, vendor or part of a single material order.
c. Clearly indicate the exact type, model number, size and special features of the proposed item.
d. Include catalog spec sheets to completely describe proposed equipment.
e. Factory order forms only showing the required capacities are not acceptable.
f. Identify all options furnished to meet specifications.
g. The Architect shall not select equipment ratings and/or options. Submittals not properly marked shall be returned without review.

C. Product Substitutions: Comply with requirements of Division 01.

D. Comparable Products Submission:

1. Document each request for a proposed comparable product with supporting data substantiating compliance of proposed product with Basis-of-Design product.
2. Use the attached “Comparable Product Submittal Form” in addition to the requirements specified herein.
3. Comparable products will not be reviewed without completion of the attached form.

E. Coordination Drawings:

1. Building Information Model (BIM): Coordination drawings shall be created from 3D BIM model of all Mechanical, Electrical, Fire Protection, and Plumbing systems. Assign an individual to serve as the main point of contact for the BIM related issues. This individual

shall have sufficient BIM experience required for the size and complexity of the project and shall have relevant proficiency in the BIM process.

a. Coordinate construction sequencing and scheduling activities and assure they are integrated with the BIM documents.
b. All design modifications in the field, RFI Responses, Submittals, and Owner requested changes shall be documented and updated in the BIM documents in a timely manner.
c. All coordination efforts and BIM updates shall be provided without changes to the contract cost and/or schedule.

2. Prepare coordination drawings to a scale of ¼”=1’0” or larger, detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components.
3. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work, including (but not necessarily limited to) the following:

a. The proposed locations of piping, valving, ductwork, equipment, and materials.
b. Planned piping layout, including valve and specialty locations and valve stem movement.
c. Planned duct systems layout, including elbow radii and duct accessories.
d. Clearances for installing and maintaining insulation.
e. Clearances for serving and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
f. Equipment connections and support details.
g. Exterior wall and foundation penetrations.
h. Fire-rated wall and floor penetrations.
i. Sizes and location of required concrete pads and bases.
j. Duct fire dampers.
k. Access doors.
l. Clearances at electrical components in accordance with the National Electrical Code.
m. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
n. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations. Show all wall mounted access doors for devices in ductwork or piping.
o. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets light fixtures, communication systems components, cable trays, sprinklers, access doors and other ceiling mounted items.

F. Closeout Submittals:

1. Record Drawings: Prepare record documents in accordance with the requirements in Division 01 Section: "Execution and Closeout Requirements". In addition to the requirements specified in Division 01, indicate the following installed conditions:

a. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
b. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 23 Section: “Identification

for HVAC Piping and Equipment." Indicate actual inverts and horizontal locations of underground piping.

c. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
d. Approved substitutions, Contract Modifications, Responses to Contractor's Request for Information, and actual equipment and materials installed.
e. Record the locations and invert elevations of underground installations.

2. Operation and Maintenance Data: Prepare operation and maintenance data in accordance with Division 01 Section: "Execution and Closeout Requirements." In addition to the requirements specified in Division 01, include the following information for equipment items:

a. List of systems and equipment requiring service manuals.
b. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
c. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
d. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
e. Servicing instructions and lubrication charts and schedules.
f. Systems and Equipment test reports.

3. Commissioning Report.

G. Color Selection: Color of finishes shall be as selected by the Architect. Submit colors of factory finished equipment for acceptance prior to ordering.

H. Products and Materials:

1. Submit complete descriptive data for all materials as follows:

a. Material specifications.
b. Data sheets.
c. Samples.
d. Capacity ratings.
e. Performance curves.
f. Operating characteristics.
g. Catalog cuts.
h. Dimensional drawings.
i. Wiring diagrams.
j. Installation instruction.
k. Any other information necessary to indicate compliance with contract documents.

2. Edit submittal data specifically for application to this project.
3. Submit actual operating conditions and characteristics for all equipment.
4. Catalogs or catalog cuts are not acceptable unless the particular item and all relative data has been marked in such a manner as to be clearly defined.
5. Color of finishes shall be as selected by the Architect. Submit colors of factory finished equipment for acceptance prior to ordering.
6. No mechanical item shall be fabricated, purchased, delivered to the site or installed, until reviewed by the Architect.

a. After the proposed materials have been approved, no substitution will be permitted except where approved by the Architect.

7. Provide shop drawing and product data submittals as indicated under individual specification sections.
8. Provide any other equipment requested by the Architect.

I. Comply with VOC limitations under section 099100.

J. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.7 QUALITY ASSURANCE

A. Underwriter's Laboratory (UL) Requirements: All equipment containing electrical components and provided under Division 23 shall bear the Underwriter's Laboratory (UL) label, as a complete packaged system.

1. Equipment not provided with a UL label shall be tested in the field, certified and provided with a listed label at the installer's expense.

a. Field testing shall be performed by a testing agency approved by the authority having jurisdiction.
b. Provide services of a UL recognized, independent Electrical Testing Laboratory (ETL) to provide field inspection and testing. Provide and ETL Label on all such equipment.

B. Fire Safe Materials: Unless otherwise indicated, materials shall conform to UL, National Fire Protection Agency (NFPA) or American Society for Testing and Materials (ASTM) standards for fire safety with smoke and fire hazard rating not exceeding flame spread of 25 and smoke developed of 50.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with Division 01 Section: "Product Requirements" : Product storage and handling requirements.

1. Deliver, store, and handle products according to manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
2. Schedule delivery to minimize long-term storage at Project Site and to prevent overcrowding of construction spaces.
3. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
4. Deliver products to Project Site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
5. Inspect products upon delivery to ensure compliance with Contract Documents and to ensure that products are undamaged and properly protected.
6. Store products in manner that will facilitate inspection and measurement.
7. Store materials in a manner that will not endanger project structure.

8. Store products subject to damage by elements above ground, under cover in a weather tight enclosure, with ventilation adequate to prevent condensation.
9. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather protection requirements for storage.

1.9 SEQUENCING

A. Coordinate mechanical equipment installation with other building components.

B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.

E. Coordinate connection of electrical services.

F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

G. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces.

H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

1.10 PRODUCT WARRANTIES

A. Division 01 Section: “Execution and Closeout Requirements”: Product warranties and product bonds

B. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

C. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include project-specific information and properly executed.
2. Refer to Divisions 01 through 26 Sections for specific content requirements and particular requirements for submitting special warranties.

D. Submittal Time: Comply with requirements in Division 01 Section: “Execution and Closeout Requirements.”

1.11 DISCREPANCIES

A. Where discrepancies occur between the drawings and specifications or within either document itself, the item or arrangement of better quality, greater quantity or higher cost shall be included in the contract price. The Architect shall decide on the item and manner in which the work shall be provided, based on the design intent of the documents.

1.12 SPECIAL TOOLS & OPERATING ACCESSORIES

A. A. Whenever any products provided under this Division have tamperproof, special or restrictive hardware, as specified or where provided from the manufacturer as standard or optional construction, provide a minimum of two (2) matching tools, bits, sockets, etc. needed for operation and/or access to such items. This shall include, but is not limited to:

1. Tamperproof screws, bolts, etc. on devices, enclosures, covers, etc.
2. Penta-head bolts used on handhole and/or manhole lids.
3. Penta-head bolts used on switchgear, transformers, etc.
4. Any other special tools which are unique to that product.

1.13 ELECTRONIC CAD DOCUMENTS

A. Requests for electronic CAD documents will be accommodated to the contractors and installers upon their completion of Bowman’s electronic document release of liability form.

1.14 PRE-SUBMITTAL MEETINGS

A. Division 01 Section: “Administrative Requirements”: Pre-Installation Meeting.

B. Pre-Submittal Meetings: After approval of the material and equipment list and prior to submitting equipment (variable speed drives, building automatic temperature control system, and remote energy management system, etc.) shop drawings, the pre-submittal coordination meeting(s) shall be held at the Engineer’s Office. The attendees shall include at the minimum:

1. Equipment Sales Representative responsible for the preparing the shop
2. drawings
3. Mechanical Contractor
4. Building ATC Contractor (Sales Representative, Control Engineer, and
5. Lead Project Installation Technician)
6. Electrical Contractor
7. Mechanical Engineer

C. The Equipment Representative and/or the Mechanical Contractor shall be responsible for e-mailing, a minimum of 48 hours in advance, a copy of the Preliminary Submittal to all named parties. The purpose of the meeting is to coordinate requirements and gain a full understanding form all parties as to what is required for a fully turnkey installation, as well as to minimize potential

rejection of shop drawings. The Mechanical Contractor shall coordinate these meetings and shall document and publish minutes of all meetings."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with Contract Documents that are undamaged and new at time of installation.

1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for complete installation and intended use and effect.
2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Where products are accompanied by the term as selected, Architect will make selection.
4. Where products are accompanied by the term match sample, sample to be matched is Architect's.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. General Compliance Requirements: Compliance requirements for individual products, as indicated in Contract Documents, are multiple in nature and may include generic descriptions, performance requirements, compliance with reference standards, conformance with graphic details and other similar forms and methods of indicating requirements, all of which must be complied with.

C. Procedures for Selecting Products: Contractor's options for selecting products are limited by Contract Document requirements, and are not controlled by industry traditions or procedures experienced by Contractor on previous construction projects.

D. Products specified by Reference Standards, Codes and Regulations: Select from among products, which can be shown to comply with referenced documents.

E. Products specified by Naming Products and Manufacturers: Select from among products listed.

F. Products specified by Naming One Manufacturer's Product as the Basis-of-Design with Reference to Other Manufacturers: Select either the specified Basis-of-Design product or an approved comparable product by one of the other named manufacturers.

1. Comply with provisions in Comparable Products Article to obtain approval for use of a comparable product by one of the named manufacturers.

G. Products specified by Naming One Manufacturer's Product and Indicating Option of Selecting Comparable Products by stating or Approved Equivalent or similar language: Select either the specified product or an approved comparable product.

1. Comply with provisions in Comparable Products Article to obtain approval for use of a comparable product by one of the named or un-named manufacturers.

H. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and, matches Architect's sample. Architect's decision will be final on whether proposed product matches satisfactorily.

I. Visual Selection Specification: Where Specifications include the phrase as selected from manufacturer's standard colors, patterns, textures or similar phrase, select a product that complies with other specified requirements. Architect will select color, pattern, and texture.

1. Standard Range: Where Specifications include the phrase standard range of colors, patterns, textures or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
2. Full Range: Where Specifications include the phrase full range of colors, patterns, textures or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Where Basis-of-Design products are specified by name, submit the following, in addition to other required submittals, to obtain approval of a comparable product by one of the named manufacturers:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work. Use the attached Comparable Products Submittal Form in addition to requirements listed herein.
2. Detailed comparison of significant qualities of proposed product with the Basis-of-Design product in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, serviceability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

2.3 GROUT

A. Non-shrink, Nonmetallic Grout: ASTM C 1107, Grade B, “Packaged Dry, Hydraulic-Cement Grout (Nonshrink)”, “latest edition”.

1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory-packaged.

2.4 ACCESS DOORS AND PANELS

A. Provide manufactured steel door assemblies consisting of:

1. Hinged door.

2. Flush screwdriver camlocks and frame.

B. Doors shall be Milcor Metal Access doors. Provide key locks where indicated.

C. Design shall be provided for the following installations:

1. Masonry or Dry Wall: Style M.
2. Hard Finish Plaster: Style AP.
3. Fire rated dry wall ceilings: Style CFRAD, 1 hour combustible floor ceiling system, 1 hour non-combustible floor ceiling system, 3 hour non-combustible floor ceiling system.
4. Suspended ceilings: Style CT.
5. Security: Style 3211.

PART 3 - EXECUTION

3.1 PREPARATION

A. Interface With Site Utility Companies:

1. Contact MISS UTILITY prior to any excavation or underground work.
2. Contact local utility companies (water, sewer, etc.) immediately upon award of contract. Do not install related equipment until fully coordinated with appropriate utilities.
3. Provide all construction schedules, dates of requested services, outage windows, equipment locations, etc. necessary for utility work.

3.2 INSTALLATION

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where systems, materials and equipment are intended for overhead installation, and where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown

only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.

9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.
10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install access panel or doors where units are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section: "Access Doors and Frames" and within this section.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

B. Rough-In

1. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
2. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

C. Housekeeping and Equipment Pads

1. Construct pads of dimensions indicated, but not less than 4 inches larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi, 28-day compressive strength concrete and reinforcement bars as specified in Division 03 Section: "Cast-in-Place Concrete."

D. Erection of Metal Supports and Anchorage

1. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
2. Field Welding: Comply with AWS D1.1, "Structural Welding Code -Steel", "latest edition".

E. Erection of Wood Supports and Anchorage

1. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.
2. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
3. Attach to substrates as required to support applied loads.

F. Grouting

1. Install nonmetallic non-shrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.
2. Clean surfaces that will come into contact with grout.
3. Provide forms for placement of grout, as required.
4. Avoid air entrapment when placing grout.
5. Place grout to completely fill equipment bases.
6. Place grout on concrete bases to provide a smooth bearing surface for equipment.
7. Place grout around anchors.

8. Cure placed grout according to manufacturer's printed instructions.

G. Lintels

1. Lintels shall be provided for openings in masonry, brick, concrete, etc. walls to accommodate work of this division.

a. Lintels shall be provided under this division when not being provided under other divisions. Lintels shall be approved by the Architect.

3.3 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 01 Section: "Execution and Closeout Requirements". In addition to the requirements specified in Division 01, the following requirements apply:

1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Remove samples of installed Work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Architect, uncover and restore Work to provide for Architect observation of concealed Work.

C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, heating units, ductwork, plumbing fixtures and trim, and other mechanical items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.4 PAINTING AND FINISHING

A. Division 09 Section: "Painting and Coating” for field painting requirements.

B. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Do not paint manufacturer's labels or tags.

3.5 CONSTRUCTION

A. Cutting, Welding, Burning

1. Before commencing any cutting, welding, burning, brazing (pipe sweating), obtain a hot work permit from Environmental Health and Safety.
2. The hot work permit copy shall remain on the job site at the hot work location until such work is completed at which time the permit shall be returned to Environmental Health and Safety.

3.6 PENETRATION OF WATERPROOF CONSTRUCTION

A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls and interior waterproof construction.

B. Furnish and install drains, curbs, vent assemblies, sleeves, flashing, etc. specifically designed for application to the particular construction. Install system in accordance with the roofing manufacturer's instructions.

3.7 EXCAVATION AND BACKFILLING

A. General

1. Perform all necessary excavation, for installation of work under Division 23**,** in accordance with Division 31.

3.8 CLEANING

A. Clean surfaces prior to application of insulation, adhesives, coating, and paint.

B. Provide factory applied finish where specified.

C. Protect all finishes, and restore all finishes to their original condition if damaged as a result of work under Division 23.

D. Remove all construction marking and writing from exposed equipment, ductwork, piping and building surfaces.

E. General: General cleaning during construction is required by the General Conditions and included in Section Temporary Facilities.

F. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

G. Remove all mechanical clipping, wiring, nuts, bolts, etc. left on top of ceilings and ceiling tiles.

3.9 PROTECTION

A. Protect work, material and equipment from weather and construction operations before and after installation.

B. Properly store and handle all materials and equipment.

C. Cover temporary openings in piping, ductwork and equipment to prevent the entrance of water, dirt, debris, and other foreign matter.

D. Ducts with internal duct liner shall be continuously protected from fabrication, transport to the job site, temporary storage, and during installation such that no water, dirt, debris, and other foreign matter is introduced to the liner.

3.10 LUBRICATION

A. All bearings, motors and all equipment requiring lubrication shall be provided with accessible fittings.

B. Before turning over the equipment to the Owner, provide the following:

1. Fully lubricate each item of equipment.
2. Provide 1 year's supply of lubricant for each type of lubricant.
3. Provide complete written lubricating instructions, together with diagram locating the points requiring lubrication.

C. Motors and equipment shall be provided with grease lubricated roller or ball bearings with Alemite or equal extended grease fittings and drain plugs.

3.11 ELECTRICAL WORK

A. It is the intent to provide a complete and operational system. The work between Division 23 and 26 is complementary and is meant to produce a single and operating system. Contractor shall make its own determination as to the distribution of responsibility among the various trades.

B. All electrical work performed under Division 23 shall be provided in accordance with Division 26.

3.12 PROVISIONS FOR ACCESS

A. Furnish and install adequate access to all HVAC and plumbing components. The following list shall be used as a guide only:

1. Mechanical equipment.
2. Valves.
3. Dampers and operators.
4. Filters.
5. Heating and air conditioning units.
6. Controls.
7. Cleanouts.
8. Traps.

9. Automatic temperature control panels.
10. Coils.

B. Access shall be adequate as determined by the Architect.

C. Refer to contract drawings where panels have been specifically located.

D. Provide additional panels for adequate access as indicated in paragraph A above.

E. Where access is by means of liftout ceiling tiles or panels mark each panel using small color-coded or numbered tabs. Provide an index chart for identification. Place markers in corner of tile.

3.13 OPERATION OF EQUIPMENT

A. Clean all systems and equipment prior to initial operation for testing and balancing.

B. Do not operate equipment unless all proper safety devices or controls are operational.

C. Provide all maintenance and service for equipment, which is operated during construction.

D. Where specified and otherwise required, provide the services of a manufacturer's factory trained service organization to start the equipment.

E. Do not use mechanical systems for temporary services during construction unless authorized in writing by the Architect.

1. Where such authorization is granted, temporary use of equipment shall not limit or otherwise affect warranties or guarantees of the work.

F. Upon completion of work, clean and restore all equipment to new conditions and replace all filters.

3.14 DEMONSTRATION

A. Demonstrate operation and maintenance of equipment and systems to Owner’s personnel a minimum two (2) weeks prior to date of final inspection.

1. For equipment requiring seasonal operation, perform instructions for other seasons at the same time.
2. Training period shall be performed within 1 - two week period.

B. Use operation and maintenance manuals and video as basis of instruction. Review contents of manual and video with personnel in detail to explain all aspects of operation and maintenance.

C. Demonstrate the following:

1. Start up.
2. Operation.
3. Control.
4. Adjustment.
5. Trouble shooting.

6. Servicing.
7. Maintenance.
8. Shutdown.

D. Provide at least 40 hours straight time instruction to the operating personnel.

1. This instruction period shall consist of not less than five-8 hour days.
2. Time of instruction shall be designated by the Owner.
3. This instruction shall be in addition to instructional requirements of specific equipment specified elsewhere in Division 23.

3.15 WALL AND FLOOR PENETRATION

A. All penetrations of partitions, walls and floors by ducts, piping or conduit under Division 23 shall be sealed and caulked. Provide U.L. listed fire stopping systems at penetrations through fire rated walls.

3.16 EQUIPMENT PROVIDED UNDER ANOTHER DIVISION AND BY OTHERS

A. Make all system connections required to equipment furnished and installed under another division and by others.

B. It shall be the responsibility of the Contractor to coordinate all necessary data from the equipment supplied under other Divisions.

3.17 MECHANICAL EQUIPMENT SERVICE PLATFORMS

A. Where mechanical equipment is located on a roof or elevated structure that requires access such that personnel will have to climb over ductwork or higher than 16 feet above grade to access the equipment, a means to access the equipment shall be provided.

B. Provide catwalks around the entire perimeter of equipment to match manufacturer required clearance area. Minimum 36” from perimeter of unit

C. Provide side edge railings that extend above the catwalk not less than 30” above the catwalk

3.18 PROJECT PUNCH OUT

A. Architect/Engineer will perform punch out reviews and will provide the Contractor with a list of punch list items to be completed before contract close out. Each and every punch list item shall be initialed and dated by the Contractor when the work is complete. The Architect/ Engineer will not perform any punch list verification until all items have been completed, initialed, dated and the list returned to the Architect/Engineer. If any items have been initialed as being completed by the Contractor and the Architect/Engineer determines that the work is not complete, the Architect/Engineer shall be reimbursed by the Contractor at his regular hourly rate for any and all items requiring revisiting of the site by the Architect/Engineer. Reimbursement will be made by deducting the Architect/Engineer fee from the Contractor's final payment.

3.19 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section “Commissioning”.

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable

COMPARABLE PRODUCT SUBMITTAL FORM

Table of Compliance (Sample)

Shop Drawing and Product Data Submittal

The Contractor shall prepare a Table of Compliance Form similar in format to the sample shown below to facilitate and expedite the Shop Drawing and Product Data Review. Failure to comply with this requirement will be basis for rejecting the Submittal.

The Table of Compliance Form will list and compare the performance parameters as the submitted equipment to that listed on equipment schedule and specifications as basis of design. All non-compliance items (differences) must be explained in full, indicating their impact, if any, on maintainability, durability, energy use, operating costs, code compliance and environmental considerations.

(Sample)

TABLE OF COMPLIANCE

EQUIPMENT: _____ SPEC. SECTION: _____

BASIS OF DESIGN SAMPLE ITEMS	DRAWINGS	SUBMITTED	EXPLANATION
Flow (Cfm Or Gpm)			
Ext. Static Press.			
Head (Ft.)			
Electrical Requirements			
Cooling Capacity			
Heating Capacity			
Discharge Air Temp.			
Filter Type & Eff.			
Equipment Eff. (Eer)			
Sound Data			
Weights			
Etc.			

Specifications:			
Quality assurance compliance (ARI)			
(ASHRAE)			
(AMCA)			
(UL)			
Specifications: List each and every specification paragraph			
Etc.			
Other:			

END OF SECTION

SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, and the other sections of Division 23.

1.2 SUMMARY

A. Section includes:

1. Section includes single- and three-phase motors for application on equipment provided under other sections and for motors furnished loose to Project.
2. Source Quality Control.
3. Bearing Protection Ring.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 23 Section: “Common Work Results for HVAC.”
2. Division 23 Section: “Identification for HVAC piping and Equipment.”
3. Division 23 Section: “HVAC Fans.”
4. Division 26 Section: “Common Work Results for Electrical”
5. Division 26 Section: “Grounding and Bonding for Electrical Systems.”
6. Division 26 Section: “Identification for Electrical Systems.”

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”)

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generator.

C. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.4 SUBMITTALS

A. Division 01 Section – “Submittal Procedures”: Submittal Procedures.

B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

C. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

D. Comply with VOC limitations under section 099100.

E. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.

B. Testing Agency: Company who is a member of the International Electrical Testing Association and specializing in testing products specified in this section with minimum five years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section – “Product Requirements”: Product storage and handling requirements.

B. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

C. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

D. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR MOTORS

A. General: Requirements below apply to motors covered by this Section except as otherwise indicated.

1. Motors 3/4 hp and Larger: Three-phase motor as specified below.

2. Motors Smaller Than 3/4 hp: Single-phase motor as specified below

3. Frequency Rating: 60 Hz.

4. Voltage Rating: Determined by voltage of circuit to which motor is connected for the following motor voltage ratings (utilization voltages):

   a. 120 V Circuit: 115 V - motor rating.
   b. 208 V Circuit: 200 V - motor rating.
   c. 240 V Circuit: 230 V - motor rating.
   d. 480 V Circuit: 460 V - motor rating.

5. Minimum service factor shall be 1.15 and shall apply at frequency and utilization voltage at which motor is connected. Provide motors, which will not operate in service factor range when supply voltage is within 10 percent of motor voltage rating.

6. Capacity: Sufficient to start and operate connected loads at designated speeds in indicated environment, and with indicated operating sequence, without exceeding nameplate ratings. Provide motors rated for continuous duty at 100 percent of rated capacity.

7. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

8. Enclosure: Open driproof, unless otherwise specified. Provide screen over slots, where slots will permit passage of human extremities.

9. Provide adjustable motor slide base for belt driven equipment. Include adjusting bolts and locknuts.

10. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

11. Motors that operate with Variable Frequency Drives to meet the MG 1 Part 31 specifications with insulation that can withstand 1600 V peak voltage and a 1 msec rise time and improved baring lubrication for higher temperature operation

B. Minimum nominal full load efficiency for NEMA design B motors shall be as follows:

	Open Motors			Enclosed Motors		
	2-pole	4-pole	6-pole	2-pole	4-pole	6-pole
HP	3600 RPM	1800 RPM	1200 RPM	3600 RPM	1800 RPM	1200 RPM
1	77.0	85.5	82.5	77.0	85.5	82.5
1.5	84.0	86.5	86.5	84.0	86.5	87.5
2	85.5	86.5	87.5	85.5	86.5	88.5
3	85.5	89.5	88.5	86.5	89.5	89.5
5	86.5	89.5	89.5	88.5	89.5	89.5
7.5	88.5	91.0	90.2	89.5	91.7	91.0
10	89.5	91.7	91.7	90.2	91.7	91.0
15	90.2	93.0	91.7	91.0	92.4	91.7

20	91.0	93.0	92.4	91.0	93.0	91.7
25	91.7	93.6	93.0	91.7	93.6	93.0
30	91.7	94.1	93.6	91.7	93.6	93.0
40	92.4	94.1	94.1	92.4	94.1	94.1
50	93.0	94.5	94.1	93.0	94.5	94.1

C. Minimum full load efficiency for polyphase small electric motors shall be as follows:

	Open Motors		
	2-pole	**4-pole**	**6-pole**
HP	**3600 RPM**	**1800 RPM**	**1200 RPM**
0.25	65.6	69.5	67.5
0.33	69.5	73.4	71.4
0.50	73.4	78.2	75.3
0.75	76.8	81.1	81.7
1.0	77.0	83.5	82.5
1.5	84.0	86.5	83.8
2.0	85.5	86.5	No Req.
3.0	85.5	86.9	No Req.

D. Minimum full load efficiency for capacitor-start capacitor-run and capacitor-start induction-run small electric motors shall be as follows:

	Open Motors		
	2-pole	**4-pole**	**6-pole**
HP	**3600 RPM**	**1800 RPM**	**1200 RPM**
0.25	66.6	68.5	62.2
0.33	70.5	72.4	66.6
0.50	72.4	76.2	76.2
0.75	76.2	81.8	80.2
1.0	80.4	82.6	81.1
1.5	81.5	83.8	No Req.
2.0	82.9	84.5	No Req.
3.0	84.1	No Req.	No Req.

E. Three-phase Motors

1. NEMA MG 1, Design B, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.

2. Insulation System: NEMA Class F.

3. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

4. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay with wiring to terminal box.

5. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

6. Sound Power Levels: Conform to NEMA MG 1.

7. Multi-Speed Motors: Separate winding for each speed.

8. Variable Speed Motors for Use With Solid-State Drives: Energy efficient, squirrel-cage induction, design B units and ratings, characteristics, and features coordinated with and approved by drive manufacturer. Motors shall be labeled to indicate that they are provided with inverter duty capability in accordance with the National Electrical Manufacturers Association NEMA MG-1, Part 31.

9. Motors for Reduced Inrush Starting: Coordinate with indicated reduced controller type and with characteristics of driven equipment load. Provide required wiring leads in motor terminal box to suit control method.

10. All motors shall be provided with manufacturer's stamped nameplate, to include all pertinent and capacity data.

F. Single-phase Motors

1. General: Conform to the following requirements except as otherwise indicated.

2. Energy Efficient Motors: One of the following types as selected to suit the starting torque and other requirements of the specific motor application.

   a. Permanent Split Capacitor.
   b. Split-Phase Start, Capacitor-Run.
   c. Capacitor-Start, Capacitor-Run.

3. Shaded-Pole Motors: Use only for motors smaller than 1/20 hp.

4. Internal Thermal Overload Protection for Motors: Protection shall automatically opens the power supply circuit to the motor, or a control circuit arranged for external connection. Protection operates when winding temperature exceeds a safe value calibrated to the temperature rating of the motor insulation. Provide device that automatically resets when motor temperature returns to normal range except as otherwise indicated.

5. Bearings: Belt connected motors and other motors with high radial forces on motor shaft shall be ball bearing type. Sealed, prelubricated sleeve bearings may be used for other single phase motors.

2.2 SOURCE QUALITY CONTROL

A. Test motors in accordance with National Electrical Manufacturers Association NEMA MG 1, including winding resistance, no-load speed and current, locked rotor current, insulation high-potential test, and mechanical alignment tests.

2.3 BEARING PROTECTION RING

A. All motors driven by a variable frequency PWM drive shall include a maintenance free, circumferential, conductive micro fiber shaft grounding ring to discharge shaft currents to ground.

B. Provide AEGIS SGR Bearing Protection Ring as manufactured by Electro Statis Technology.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: The following requirements apply to field-installed motors.

1. Install motors in accordance with manufacturer’s published instructions and the following:

   a. Direct Connected Motors: Mount securely in accurate alignment. Connect to driven equipment with coupler of appropriate type and material for the given duty. Coupler shall be selected for high and range of motor application.
   b. Belt Drive Motors: Use adjustable motor mounting bases. Align pulleys and install belts. Use belts identified by the manufacturer and tension belts in accordance with manufacturer recommendations.

B. Install engraved plastic nameplates in accordance with Division 26.

C. Ground and bond motors in accordance with Division 26.

3.2 FIELD QUALITY CONTROL

A. Division 01 Section – “Quality Requirements”: Field inspection, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.15.

3.3 VARIABLE FREQUENCY MOTORS

A. Install Bearing Protection Ring in accordance with manufacturer’s recommendations.

END OF SECTION

SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including the General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other Sections of Division 23.

1.2 SUMMARY

A. General Requirements

1. Incorporate in construction pipe hangers and supports to manufacturer's recommendations utilizing manufacturer's regular product components, parts, and assemblies.
2. Comply with maximum load ratings with considering for allowable stresses prescribed by ASME B31.1 or MS SP-58.
3. Provide support, guides and anchors that do not transmit unacceptable heat and vibration to building structure.
4. Installation of pipe hangers and supports shall be based upon the overall design concept of the piping system. The support system shall provide for and control the free movement of piping including its movement in relation to the connected equipment.
5. Provide for vertical adjustments after installation of supported material and during commissioning, where feasible, to ensure pipe is at design elevation and slope.

B. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Equipment curbs.
6. Sleeves.
7. Mechanical sleeve seals.
8. Formed steel channel.
9. Firestopping relating to HVAC work.
10. Firestopping accessories.
11. Equipment bases and supports.
12. Acoustical Sealant.
13. Non-penetrating rooftop pipe hangers, supports and equipment supports.

C. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 03 Section: "Cast-In-Place Concrete": Execution requirements for placement of concrete housekeeping pads specified by this section.
2. Division 03 Section: "Concrete Forming and Accessories": Execution requirements for placement of inserts or sleeves in concrete forms specified by this section.

3. Division 07 Section: “Firestopping”: Product requirements for firestopping for placement by this section.
4. Division 07 Section: “Joint Protection”: Product requirements for sealant materials for placement by this section.
5. Division 09 Section: “Painting and Coating”: Product and execution requirements for painting specified by this section.
6. Division 23 Section: “Common Work Results for HVAC.”
7. Division 23 Section: “Vibration and Seismic Controls for HVAC Piping and Equipment”: Product and execution requirements for vibration isolators.
8. Division 23 Section: “HVAC Insulation.”

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”)

A. American Society of Mechanical Engineers:

1. ASME B31.5 - Refrigeration Piping.

B. ASTM International:

1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
5. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

D. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports – Selection and Application.
3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

F. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

G. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.4 DEFINITIONS

(Unless otherwise noted, references apply to "latest editions.")

A. Terminology used in this Section is defined in Manufacturer's Standardization Society Specification 90, "Valve and Fittings Standards."

B. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.5 SUBMITTALS

A. Division 01 Section: "Submittal Procedures": Submittal procedures.

B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.

C. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers. Submit sizing methods sealed by a registered professional engineer.

F. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

H. Firestopping Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

I. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

J. Submit following in accordance with Conditions of Contract and Division 1 Specifications:

1. Shop drawings of items.

2. Complete description of products to be supplied including product data, dimensions materials of construction and specifications.
3. Installation instructions for each product.
4. Layout of piping and ductwork to be isolated including vertical risers showing:

    a. Support points.
    b. Weight at support points.
    c. Isolator type.
    d. Static deflection expected under actual load.
    e. Specified static deflection.
    f. Additional deflection to solid under actual load.
    g. Ratio of spring height under load to spring diameter.
5. Steel rails, steel base frames, and concrete inertia bases showing all steel work, reinforcing, vibration isolator mounting attachment method and location of equipment attachment bolts.
6. Special details at large scale and other necessary information to convey understanding of work.

K. Submission of samples may be requested for each type of vibration isolation device. After approval, samples shall be returned for installation at job site.

L. Comply with VOC limitations under section 099100.

M. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.6 CLOSEOUT SUBMITTALS

A. Division 01 Section: “Execution and Closeout Requirements”: Closeout procedures.

B. Project Record Documents: Record actual locations of valves, equipment and accessories.

C. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

1.7 QUALITY ASSURANCE

(Unless otherwise noted, references apply to “latest editions.”)

A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code – Steel.”

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. NFPA Compliance: Comply with NFPA 13, “Installation of Sprinkler Systems,” for hangers and supports used as components of fire protection systems.

C. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70 “Definitions.”

1. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7, “Definition and requirements for a nationally recognized testing laboratory.”

D. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.

E. Supply and install incidental materials needed to meet requirements, even if not expressly specified or shown on drawings without claim for additional payment.

F. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

G. Should any rotating equipment cause excessive noise or vibration, rebalance, realign or do other remedial work to reduce noise and vibration levels. Excessive is defined as exceeding manufacturer's specifications for unit in question.

H. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

    a. Floor Penetrations Within Wall Cavities: T-Rating is not required.

I. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.

1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

J. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.

K. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

L. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

M. Perform Work in accordance with ASME B31.1 and ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

N. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.9 PRE-INSTALLATION MEETINGS

A. Division 01 Section: “Administrative Requirements”: Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section: “Product Requirements” for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section: “Product Requirements”: Environmental conditions affecting products on site.

B. Do not apply firestopping materials when temperature of substrate material and ambient air are not in accordance with the manufacturer’s installation procedures.

C. Maintain manufacturer’s required temperature before, during, and after installation of firestopping materials for minimum periods of time as required by the manufacturer.

D. Provide ventilation in areas to receive solvent cured materials.

1.12 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.13 WARRANTY

A. Division 01 Section: “Execution and Closeout Requirements”: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for pipe hangers and supports.

PART 2 - PRODUCTS

(Unless otherwise indicated, references apply to "latest editions.")

2.1 MATERIALS

A. Structural Steel: ASTM A 36, "Carbon Structural Steel," steel plates, shapes, and bars, black and galvanized.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, "Track Bolts and Nuts," steel, hex-head, track bolts and nuts.

C. Washers: ASTM F 844, "Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use," steel, plain, flat washers.

D. Grout: ASTM C 1107, Grade B, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)," non-shrink, nonmetallic.

1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is non-staining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Water: Potable.
4. Packaging: Premixed and factory-packaged.

2.2 HANGERS AND SUPPORTS

A. Hangers, Supports, and Components: Provide factory-fabricated products as manufactured by B-Line, Tyco – (Anvil Hangers), Pipe Shields, Inc., or Erico CADDY. Basis of Design shall be B-Line.

1. Components include galvanized coatings where installed for piping and equipment that will not have a field-applied finish.
2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

B. Install rigid round, and rectangular metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards," Tables 4-1 through 4-3 and Figures 4-1 through 4-8.

C. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.

D. Support vertical ducts at a maximum interval of 16 feet and at each floor.

E. Upper attachments to structures shall have an allowable load not exceeding 3 of the failure (proof test) load but are not limited to the specific methods indicated.

F. Horizontal Non-Insulated Copper Piping Hangers:

1. Two inch and smaller: Figure No. B3104 CTC.
2. Two and one-half inch and larger: Figure No. B3104 CT.

G. Insulated Horizontal Piping Hangers: refrigerant piping:

1. Two inch and smaller: Figure No. B3108 with metal shield, Figure No. B3151.
2. Two and one-half inch and larger: Figure No. B3108 with metal shield, Figure No. B3151.

H. Vertical Piping Riser Clamps:

1. Copper Pipe: Figure No. B3373CT.
2. Steel Pipe: Figure No. B3136 and B3137.

I. Beam Clamps and Attachments:

1. For bolt-on locations to structure, Figure Nos. B3291, B3036, or B3050.
2. Welded beam attachments, Figure No. B3083.

J. Brackets:

1. For equipment and piping adjacent to walls or steel columns, Figure Nos. B3066, B3063 and B3067 depending on weight to be supported.

K. Pipe Rests:

1. For pipes close to floor where no expansion provision is required, Figure No. B3088T base stand with B3093 adjustable pipe saddle support.

L. Hanger Rods:

1. Hanger rod, Figure No. B3205.
2. Continuous threaded rod, Figure No. ATR.
3. Eye rods, Figure No. B3210 or B3211, depending on load supported.

M. Trapeze Hangers - Direct Mounting Hangers:

1. Grinnell, Figure No. 46.

N. Protection Saddles:

1. Cast iron pipe, insulated, Figure No. B3108 with metal shield, Figure No. B3151.
2. For high temperature steel pipe, insulated, No. B3160, B3161, B3162, B3163, B3164, or B3165.

O. Pipe Roll Stands:

1. For support of pipe where axial movement is encountered: Figure No. B3117SL where no vertical adjustment is required; and Figure No. B3118SL where vertical adjustment is required.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

1. Carpenter & Paterson, Inc.
2. Erico/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 EQUIPMENT CURBS

A. General

1. Fabrication: Welded 18 gage galvanized steel shell and base, mitered 3 inch cant, 1-1/2 inch thick insulation, factory installed wood nailer.

B. Rooftop Units, and Dedicated Outside Air Units

1. Curbs shall to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit.
2. Solid bottom curb shall be factory assembled and fully lined with 1 inch neoprene coated fiberglass insulation and include a wood nailer strip.
3. Manufacturers
   a. Basis of Design shall be BRD Noise and Vibration Control
   b. Alternate manufacturers shall be submitted for review.
4. Seismic/Vibration curbs
   a. HUSH MOUNT™ model RSVC-200: 2” static deflection
   b. The structural steel spring isolation curbs shall bear directly on the roof support structure and be flashed and waterproofed into the roof’s membrane waterproofing system.
      1) The curb shall be capable of being re-flashed without lifting the unit.
   c. Equipment manufacturer’s or field fabricated curbs shall not be used.
   d. Curb sides and ends shall be manufactured from minimum 14 ga. G90 galvanized sheet metal (expanded metal or painted steel is not acceptable), reinforced and cross braced as required.
   e. All springs shall provide a minimum of 85% vibration isolation efficiency
      1) All springs shall be adjustable for leveling.
      2) Spring assemblies shall contain restraints and snubbers to resist wind and seismic forces.
   f. Spring static deflection and seismic performance criteria shall be as shown or indicated on the drawings, schedules or in the vibration control specification.

g. The curb shall accept standard 2” roof insulation supplied and installed by the roofing contractor.
h. An air tight neoprene seal shall be incorporated into the curb design to prevent air leakage or infiltration. The seal shall be affixed after spring adjustments and leveling have been completed.
i. Wood nailer and flashing shall be provided and curbs shall be manufactured to NRCA standards.
j. Curb height shall be 24” high minimum or as shown on the drawings.
k. Curbs shall be shipped pre-assembled. Knocked down kits are not acceptable.
l. All non-galvanized materials shall be prime paint finished.
m. All duct supports, bracing, flashing and safing as required.
n. Unless otherwise recommended by the RTU manufacturer, all curbs shall be full perimeter type. Curbs with condenser pedestal rails are unacceptable.

5. In-Curb Composite Acoustical Treatment

a. HUSHCORE™ BUB-755 acoustical composite
b. The overall installed thickness shall be no greater than 10” for BUB-755 products
c. Shall have a thermal value of R-27
d. Shall meet Class “A” per ASTM E84 for flammability
e. The composite panels shall get HUSH SEALANT™ model HSAC-100 acoustical grade caulk at seams and all perimeter edges inside the curb
f. Shall have 65% post-consumer recycled content

6. Decking

a. Decking shall be maintained inside the RTU roof curb to a clearance of ¼” maximum around all duct drops but never contact the duct.
b. Pack all air gaps around duct drops for return and supply with HBNF-400-NC and seal with HUSH SEALANT™ HSAC-100.

7. Inspections

a. The manufacturer or their local authorized agent shall inspect the in-curb deck system work on site prior to lowering of the units and issue a letter of certification stating that the products have been properly installed and sealed around all ductwork and drops to eliminate air gaps which can compromise performance.

8. Performance

a. To assure optimized aerodynamic and acoustic performance as well as proper integration and coordination of the final installation, the PLUS™ System shall be supplied by the rooftop unit manufacturer as part of a turnkey package.
b. HUSHCORE™ In-Curb Composite Acoustical Treatment Performance
1) The combination of all layers shall be tested for Sound Transmission Loss in accordance with procedure ASTM E-90-10. The assembly shall be rated at not less than STC-52 with 1/3 octave performance values as listed below for sound radiation through the deck inside the curb.

Freq. (Hz)	80	100	125	160	200	250	315	400	500	630	800	1K
TL (dB)	26	27	33	32	35	42	45	45	50	56	59	60

Freq. (Hz)	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	STC

TL (dB)	62	63	64	65	67	71	74	78	80	80	52

c. A copy of the test report by an accredited lab shall be included in the submittals to document the above performance

2.5 FLASHING

A. Metal Flashing: 26 gage thick galvanized steel.

B. Metal Counterflashing: 22 gage thick galvanized steel.

C. Lead Flashing:

1. Waterproofing: 5 lb./sq. ft sheet lead.
2. Soundproofing: 1 lb./sq. ft sheet lead.

D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements

2.6 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sleeves for Round Ductwork: Galvanized steel.

D. Sleeves for Rectangular Ductwork: Galvanized steel or wood.

E. Sealant: Acrylic

2.7 MECHANICAL SLEEVE SEALS

A. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.8 FORMED STEEL CHANNEL

A. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.9 FIRESTOPPING

A. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Single component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

2.10 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:

1. Mineral fiberboard.
2. Mineral fiber matting.
3. Sheet metal.
4. Plywood or particle board.
5. Alumina silicate fire board.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:

1. Furnish UL listed products or products tested by independent testing laboratory
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

2.11 ACOUSTICAL SEALANT

A. Sealants for acoustical purposes shall be one of following non-setting sealants:

Acoustical sealant.....D.A.P.

BR – 96 .....Pecra

Acoustical sealant .....Tremco

Acoustical sealant .....U.S.G.

2.12 NON-PENETRATING ROOFTOP PIPE HANGERS, SUPPORTS AND EQUIPMENT SUPPORTS

A. Provide with bases that rest upon walk pads. Bases shall have rounded edges to prevent damage to the roof, carbon black additive in polycarbonate for UV stabilization, and edges to prevent damage to the roof, carbon black additive in polycarbonate for UV stabilization, and stainless steel all threads for adjustability.

B. Mechanical piping shall be supported by rollers.

C. Condensate lines shall be supported by strut, similar to Miro Industries Model 2.5 CS-5".

D. Mechanical Rooftop Mounted Equipment Supports (VRF Outdoor Units): Provide bases supporting; hot-dip galvanized grating to spread weight across roof membrane.

1. Heavy Duty: Base Material Stainless Steel or hot-dip galvanized total load up to 2lb. per square inch, 12 by 16 inch base (similar to Miro Industries Model Mechanical Support-HD, or Big Foot Multi Frame).

E. Accessories:

1. Support Pads: Pads shall be 15-3/4 by 19-3/4 inch square, 1/8 inch thick, flexible PVC with carbon black additive for UV stabilization
2. Deck Plates: Provide square metal deck plates with curved up edges, to spread load and protect roof membrane, sizes and quantities manufacturer's recommendations.

PART 3 - EXECUTION

(Unless otherwise noted, references apply to "latest editions.")

3.1 EXAMINATION

A. Division 01 Section: "Administrative Requirements": Verification of existing conditions before starting work.

B. Verify openings are ready to receive sleeves.

C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material. Install damming material to arrest liquid material leakage.

B. Install damming materials to arrest liquid material leakage.

C. Remove incompatible materials affecting bond.

D. Drilling or cutting of structural members shall be as detailed / directed by structural engineer.

3.3 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Comply with MSS SP-69 “Pipe Hangers, and Supports C Selection and Application”, and SP-89, “Pipe Hangers and Supports - Fabrication and Installation Practices”. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. Piping shall be supported independently from equipment connections. Supports shall not interfere with removal of equipment.

B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.

C. Install supports with maximum spacings complying with MSS SP-69, “Pipe Hangers, and Supports C Selection and Application” and as specified in Division 23 Section: “Pipes and Tubes for HVAC Piping and Equipment.”

D. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69, “Pipe Hangers, and Supports C Selection and Application”. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts in new construction prior to placing concrete. Install reinforcing bars through openings at top of inserts.

F. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Does not use in lightweight concrete slabs or in concrete slabs less than 4 inches (100 mm) thick.

G. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches (100 mm) thick.

H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

I. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36, “Carbon Structural Steel,” 2001, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1, “Structural Welding Code – Steel.”

J. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

L. Place hangers within 12 inches of each horizontal elbow.

M. Use hangers with 1-1/2 inch minimum vertical adjustment.

N. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

O. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

P. Support riser piping independently of connected horizontal piping.

Q. Provide copper plated hangers and supports for copper piping.

R. Design hangers for pipe movement without disengagement of supported pipe.

S. Prime coat exposed steel hangers and supports. Hangers and supports located in, pipe shafts, and suspended ceiling spaces are not considered exposed.

T. Provide clearance in hangers and from structure and other equipment for installation of insulation.

U. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

V. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.

W. Insulated Piping: Provide continuous insulation and vapor barrier through hangers and supports. Comply with the following installation requirements.

1. Riser Clamps: Attach riser clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9. Insulate clamps on piping with insulation and vapor barrier.
2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
3. Shields: Install MSS Type 40, protective shields on cold piping with vapor barrier. Shields span an arc of 180 degrees (3.1 rad) and have dimensions in inches (mm) not less than the following:

NPS (Inches)	LENGTH (Inches)	THICKNESS (Inches)
1/4 to 3 1/2	12	0.048
4	12	0.060
5 and 6	18	0.060

4. Pipes 4 Inches and Larger: Include treated wood inserts.
5. Insert Material: Length to equal to the length of the protective shield.
6. Conform to the table below for maximum spacing of supports and rod sizes:

a. Steel and Copper Pipe:

Nom. Pipe Size – In.	Steel Pipe Max. Span – Ft.	Copper Tube Max. Span – Ft.	Min. Rod Dia. – In.
Up to 3/4	7	5	3/8
1	7	6	3/8
1 1/4	7	7	3/8
1 1/2	9	8	3/8
2	10	8	3/8
2 1/2	11	9	1/2
3	12	10	1/2
3 1/2	13	11	1/2
4	14	12	5/8 (1/2 for copper)
5	16	13	5/8 (1/2 for copper)
6	17	14	3/4 (5/8 for copper)

b. Support vertical steel pipe and copper tube at each floor.

X. Equipment Supports:

1. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
2. Grouting: Place grout under supports for equipment and concrete bases. Make a smooth bearing surface.
3. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6" beyond supported equipment.
4. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
5. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
6. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.

B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.6 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 3 ½" thick and extending 6" beyond supported equipment.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Division 22 Section: "Vibration and Seismic Controls for Plumbing and Equipment."

3.7 INSTALLATION - FLASHING

A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size.

For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.

C. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.8 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 2 inches above finished floor level. Caulk sleeves.

E. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

F. Install stainless steel escutcheons at finished surfaces.

3.9 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating to uniform density and texture.

D. Compress fibered material to maximum 40 percent of its uncompressed size.

E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

F. Place intumescent coating in sufficient coats to achieve rating required.

G. Remove dam material after firestopping material has cured.

H. Fire Rated Surface:

1. Seal opening at floor, wall, partition, ceiling, and roof as follows:

    a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
    b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
    c. Pack void with backing material.

d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

2. Where pipe, duct, conduit, etc. penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

I. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall, partition, floor, ceiling, and roof opening as follows:

a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
c. Install type of firestopping material recommended by manufacturer.

2. Install escutcheons floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
4. Interior partitions: Seal pipe penetrations at all rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.10 FIELD QUALITY CONTROL

1. Division 01 Section: “Quality Requirements”: Field inspection, testing, adjusting, and balancing.
2. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.11 CLEANING

A. Division 01 Section: “Execution and Closeout Requirements”: Requirements for cleaning.

B. Clean adjacent surfaces of firestopping materials.

3.12 PROTECTION OF FINISHED WORK

A. Division 01 Section: “Execution and Closeout Requirements”: Requirements for protecting finished work.

B. Protect adjacent surfaces from damage by material installation.

3.13 APPLICATIONS FOR HANGER AND SUPPORT

A. Specific hanger requirements are specified in the Section specifying the equipment and systems.

B. Comply with MSS SP-69, “Pipe Hangers and Supports C Selection and Application,” for pipe hanger selections and applications that are not specified in piping specification Sections.

3.14 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Adjust for pipe alignment and final equipment connections. Flexible connections shall not be used for adjustment of alignment.

3.15 NON-PENETRATING ROOFTOP PIPE HANGERS AND SUPPORTS

A. Determine that roof structure, roof insulation, and roof membranes are structurally adequate to support weight of pipe and supports and hangers.

B. Install supports and hangers in accordance with manufacturer's recommendations.

C. Install supports at maximum spacing of 10', unless closer spacing is required due to weight of pipe or the authority having jurisdiction's requirements. Do not exceed manufacturer's recommended load limits.

D. Support Pads: Remove rock from area to be covered by pads, apply pads on cleaned area, and center bases on top of support pads.

E. Set pipes in support without dropping or causing undue impact.

END OF SECTION

SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including the General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other Sections of Division 23.

1.2 SUMMARY

A. This Section includes vibration, wind, and seismic control for mechanical systems piping ductwork, and equipment. It is the intent of the seismic portion of this specification to keep all mechanical and electrical building system components in place during a seismic event.

B. The requirements for seismic protection measures to be applied to mechanical equipment and systems specified herein are in addition to any other items called for in other Sections of the Specifications. Provide seismic bracing for equipment and systems within the project area. Seismic forces shall be calculated by a qualified Licensed Professional Engineer. Seismic bracing and anchors shall be designed by the Licensed Professional Engineer to withstand the calculated seismic forces per the specified project conditions.

C. All HVAC components mounted outside of the building envelope (on-grade, on roof, on exterior walls, etc.) shall be mounted and supported to resist wind loads as required by the International Building Code (IBC), edition in effect by local authority having jurisdiction. Wind forces shall be calculated by a qualified licensed Professional Engineer to withstand the calculated wind forces per the specified project conditions.

D. Section Includes:

1. Materials
2. Seismic Restraints
3. Vibration Isolation Mount Types
4. Equipment Bases
5. Resilient Penetration Sleeve/Seal
6. Seismic Snubber
7. Flexible Duct Connections
8. Flexible Electrical Connection
9. Restraints
10. Grommets
11. Acoustical Sealant
12. Vibration Isolation Schedule

E. Related Sections: The following sections contain requirements that relate to this section:

1. Division 03 Section: “Cast-In-Place Concrete”: Product requirements for concrete for placement by this section.

2. Division 07 - Joint Protection: Product requirements for joint sealers specified for placement by this Section.
3. Division 08 - Louvers: Product requirements for acoustic wall louvers.
4. Division 09 Section: “Painting and Coating”: Product and execution requirements for painting specified by this Section.
5. Division 23 Section: “Common Work Results for HVAC.”
6. Division 23 Section: “HVAC Insulation.”
7. Division 23 Section: “Pipes and Tubes for HVAC Piping and Equipment.”
8. Division 23 Section: “Expansion Fittings and Loops for HVAC Piping”: Product requirements for anchors and piping expansion compensation.
9. Division 23 Section: “Hangers and Supports for HVAC Piping and Equipment”: Product requirements for pipe hangers and supports.
10. Division 23 - Testing, Adjusting, and Balancing for HVAC: Requirements for sound and vibration measurements performed independent of this Section.

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”) (FOR SEISMIC AND WIND ONLY- references apply to the edition adopted and / or referenced by the building code applicable to the project).

A. Air Movement and Control Association International, Inc.:

1. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

B. American National Standards Institute:

1. ANSI S1.4 - Sound Level Meters.
2. ANSI S1.8 - Reference Quantities for Acoustical Levels.
3. ANSI S1.13 - Methods for the Measurement of Sound Pressure Levels in Air.
4. ANSI S12.36 - Survey Methods for the Determination of Sound Power Levels of Noise Sources.
5. ANSI S12.60 - Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools.

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 68 - Laboratory Method of Testing to Determine the Sound Power in a Duct.
2. ASHRAE Handbook - HVAC Applications.

D. Air-Conditioning and Refrigeration Institute:

1. ARI 575 - Method of Measuring Machinery Sound within Equipment Space.

E. ASTM International:

1. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
2. ASTM E477 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
3. ASTM E596 - Standard Test Method for Laboratory Measurement of the Noise Reduction of Sound-Isolating Enclosures.

F. Sheet Metal and Air Conditioning Contractors' National Association:

1. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

G. International Building Code (IBC)

H. ASCE-7, Minimum Design Loads for Buildings and Other Structures

1.4 DEFINITIONS

A. Terminology used in this Section is defined in Manufacturer's Standardization Society Specification - 90, "Valve and Fittings Standards," "latest edition".

B. Life Safety Systems:

1. All systems involved with fire damper systems.
2. All HVAC systems involved with and/or connected to emergency power supply including all generators, transfer switches, transformers and all flowpaths to fire protection.

C. Positive Attachment:

1. A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided "C" type beam clamps for support rods of overhead ductwork, hydraulic piping, bus duct, or any other equipment are not acceptable on this project as seismic attachment points.

D. Transverse Bracing:

1. Restraint(s) applied to limit motion perpendicular to the centerline of the piping or duct.

E. Longitudinal Bracing:

1. Restraint(s) applied to limit motion parallel to the centerline of the piping or duct.

1.5 PERFORMANCE REQUIREMENTS

A. Provide vibration isolation on motor driven equipment over 0.5 hp, plus connected piping and ductwork.

1.6 SUBMITTALS

A. Division 01 Section – "Submittal Procedures": Submittal Procedures.

B. Product Data:

1. Submit schedule of vibration isolator type with location and load on each.
2. Submit manufacturer catalog information indicating materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.

C. Shop Drawings:

1. Indicate static and dynamic load of both inertia bases and vibration isolators.
2. Indicate assembly, materials, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for fabricated sound attenuation products.
3. Shop drawings for each type of isolator, indicating dimensions, weights, required clearances, and methods of component assembly.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions indicating that maximum room sound levels are not exceeded.

F. Manufacturer Instructions:

1. Submit special procedures and setting dimensions.
2. Indicate installation requirements maintaining integrity of sound isolation.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

H. Manufacturer Reports: Certify that sound isolation installation is complete and complies with instructions.

I. Qualifications Statements:

1. Review by duly authorized manufacturer’s representative with at least six (6) years’ experience on projects of similar scope.

J. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

K. Submit the following in accordance with Conditions of Contract and Division 1 Specifications:

1. Shop drawings of items.
2. Complete description of products to be supplied including product data, dimensions materials of construction and specifications.
3. Installation instructions for each product.
4. Tabulation showing for each vibration isolator supporting equipment:

    a. Equipment identification tag no.
    b. Isolator type.
    c. Actual load.
    d. Static deflection expected under actual load.
    e. Specified minimum static deflection.
    f. Additional deflection to solid under actual load.
    g. Ratio of spring height under actual load to spring diameter.

5. Layout of piping to be isolated including vertical risers showing:

    a. Support points.
    b. Weight at support points.
    c. Isolator type.
    d. Static deflection expected under actual load.

e. Specified static deflection.
f. Additional deflection to solid under actual load.
g. Ratio of spring height under load to spring diameter.

6. Steel rails, steel base frames, and concrete inertia bases showing all steel work, reinforcing, vibration isolator mounting attachment method and location of equipment attachment bolts.
7. Special details at large scale and other necessary information to convey understanding of work.

L. Seismic Certification and Analysis:

1. Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.
2. All restraining devices shall be tested or calculated showing maximum restraint ratings. Preapprovals based on independent testing are preferred to preapprovals based on calculations. Where preapproved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of the job location. Testing and calculations must include both shear and tensile loads as well as one test or analysis at 45° to the weakest mode.
3. Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in section 1.5 acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

M. Submission of samples may be requested for each type of vibration isolation device. After approval, samples shall be returned for installation at job site.

N. Comply with VOC limitations under section 099100.

O. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.7 QUALITY ASSURANCE

A. Perform Work according to AMCA 300, ANSI S1.13, AHRI 575 standards and ASHRAE 68 recommendations.

B. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code - Steel," “latest edition”.

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

D. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:

1. Determine vibration isolation and seismic restraint sizes and locations.
2. Provide calculations and materials if required for restraint of un-insulated equipment.
3. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.

E. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.

F. Coordinate size, location, and special requirements of vibration isolation equipment and systems with other trades. Coordinate plan dimensions with size of housekeeping pads.

G. Provide vibration isolators of appropriate sizes and proper loading to meet specified deflection requirements.

H. Supply and install incidental materials needed to meet requirements, even if not expressly specified or shown on drawings without claim for additional payment.

I. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

J. Should any rotating equipment cause excessive noise or vibration, rebalance, realign or do other remedial work to reduce noise and vibration levels. Excessive is defined as exceeding manufacturer's specifications for unit in question.

K. Speed And Balance Requirements For Rotating Equipment:

1. Fans and other rotating mechanical equipment shall not operate at speeds in excess of 80% of their critical speed.
2. Vertical vibration of rotating equipment shall not be greater than levels indicated elsewhere. Measure vibration on equipment or steel frame equipment base when equipment is mounted on its vibration isolation mounts. If equipment has inertia base, allowable vibration level is reduced by ratio of equipment weight alone to equipment weight plus inertia base weight.

Equipment Speed (rpm)	Vibration Displacement (mils, peak-to-peak)
Under 600	4
600 to 1000	3
1000 to 2000	2
over 2000	1

1.8 PREINSTALLATION MEETINGS

A. Division 01 Section - Administrative Requirements: Requirements for preinstallation meeting.

B. Convene minimum two weeks prior to commencing work of this Section.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.11 FIELD MEASUREMENTS:

A. Verify field measurements prior to fabrication.

B. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish two-year manufacturer's warranty for inertia bases.

PART 2 - PRODUCTS

2.1 INTENT

A. All vibration isolators and seismic/wind restraints described in this Section shall be the product of a single manufacturer. Acceptable manufacturers include: Vibro-Acoustics, Kinetics Noise Control, Mason Industries or a comparable acceptable manufacturer who is an active member of the Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).

2.2 MATERIALS

A. Structural Steel: ASTM A 36/A 36M, “Carbon Structural Steel,” “latest edition”, steel plates, shapes, and bars, black and galvanized.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, “Track Bolts and Nuts,” 2000, steel, hex-head, track bolts and nuts.

C. Washers: ASTM F 844, “Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use,” steel, plain, flat washers.

D. Grout: ASTM C 1107, Grade B, “Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink),” nonshrink, nonmetallic.

1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is nonstaining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Water: Potable.
4. Packaging: Premixed and factory-packaged.

2.3 SEISMIC RESTRAINT

A. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cables must be rated to achieve a certified minimum modulus of elasticity. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize clamping mechanisms to provide proper cable engagement. Cables must not be allowed to bend across sharp edges. Seismic cable assemblies are the preferred method of restraint where applicable. Cable assemblies shall be model BB/BBR as manufactured by Vibro-Acoustics, Model KSCU, KSWC, and/or KSCC as manufactured by Kinetics Noise Control, or type SCB, SCBH or SCBV as manufactured by Mason Industries, Inc., or comparable acceptable product.

B. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of 2 and arranged to provide all directional restraint. Seismic solid brace end connectors shall be steel assemblies that swivel to the final installation angle and utilize two through bolts to provide proper attachment. Solid seismic brace assemblies shall be manufactured and supplied by Vibro-Acoustics type RRK, Kinetics Noise Control or type SSB, SSBS or SSRF as manufactured by Mason Industries, Inc., or comparable acceptable product.

1. Steel angles, sized to prevent buckling, shall be clamped to duct or equipment rods utilizing ductile iron clamps at each restraint location when required after seismic force analysis completed by restraint supplier and/or restraint manufacturer’s engineers. Welding of support rods is not acceptable. Hanger rod stiffener kits shall be Model VAC as manufactured by Vibro-Acoustics, Model KHRC-B and/or KHRC-C as manufactured by Kinetics Noise Control or type SRC or UC as manufactured by Mason Industries, Inc., or comparable acceptable product.

C. Insulated Horizontal Piping Hangers: Steam and Condensate, Chilled Water, Glycol Solution, Heating Hot Water:

1. Pipe clevis cross bolt braces are required in all single clevis solid brace type restraint locations. They shall be special purpose preformed channels or angles deep enough to be held in place by bolts or straps passing over the cross bolt. Clevis cross brace shall be Model KCHB as manufactured by Kinetics Noise Control or type CCB as manufactured by Mason Industries, Inc., or comparable acceptable product.

D. Vertical Piping Riser Seismic Restraints:

1. All-directional acoustical pipe anchor, consisting of cable restraint assemblies or two sizes of steel tubing separated by a minimum 1/2" thick 60 durometer neoprene. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material should not exceed 500 psi and the design shall be balanced for equal resistance in any direction. All-directional anchors shall be Model KPA as manufactured by Kinetics Noise Control or type ADA as manufactured by Mason Industries, Inc., or comparable acceptable product.

2. Pipe guides shall consist of spring assemblies or a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2" thickness of 60 durometer neoprene. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of 1 5/8" motion, or to meet location requirements. Pipe guides shall be Model KPG as manufactured by Kinetics Noise Control or type VSG as manufactured by Mason Industries, Inc., or comparable acceptable product.

2.4 VIBRATION ISOLATION MOUNT TYPES

A. General

1. Metal parts of vibration isolation units installed out-of-doors shall be hot-dip galvanized, cadmium- plated or Neoprene-coated after fabrication. Galvanizing shall meet ASTM 144 “Salt Spray Test Standards and Federal Test Standard.”

2. Isolator types are scheduled to establish minimum standards. Optionally, labor-saving accessories can be an integral part of isolators supplied to provide initial lift of equipment to operating height, hold piping at fixed elevations during installation and initial system filling operations, and similar installation advantages. Accessories shall not degrade vibration isolation system.

B. Unit FSN (Floor Spring and Neoprene) (Type 3)

1. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 1/4" neoprene acoustical friction pad between the base plate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height. Mountings shall be type FS as manufactured by Vibro-Acoustics, Model FDS as manufactured by Kinetics Noise Control or type SLF as manufactured by Mason Industries, Inc., or comparable acceptable product.

C. Unit FSN-R (or FSNTL) (Floor Spring and Neoprene – Restrained) (or Travel Limited) (Type 4)

1. Restrained spring mountings shall have an FSN mounting within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. Installed and operating heights are equal. A minimum clearance of 1/2" shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Restraining Bolts shall have a neoprene bushing between the bolt and the housing. Limit stops shall be out of contact during normal operation. Housing shall be designed to withstand wind loads when located outdoors. Housing shall be designed to resist all seismic forces if applicable. Mountings shall be type SFS, CSR, or SCSR as manufactured by Vibro-Acoustics, Model FLS, FLSS, or FHS as manufactured by Kinetics Noise Control or type SLR (including all variants) or SSLFH as manufactured by Mason Industries, Inc., or comparable acceptable product.

D. Unit HSN (Hanger Spring and Neoprene) (Type 3)

1. Hangers shall consist of rigid steel frames containing minimum 1-1/4" thick neoprene or pre-compressed elastomer coated fiberglass elements at the top and a steel spring with general characteristics as in specification 2.4.b.1 seated in an optional steel washer reinforced neoprene cup on the bottom. The neoprene element and the optional cup shall have neoprene bushings projecting through the steel box. To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc from side to side before contacting the rod bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30 degree capability. Hangers shall be type SHR/B as manufactured by Vibro-Acoustics, model SRH or SFH as manufactured by Kinetics Noise Control or type 30N as manufactured by Mason Industries, Inc., or comparable acceptable product.

2.5 EQUIPMENT BASES

A. Unit RCI (Type D)

1. General Requirements for Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air and watertight curb and rail designed to resiliently support equipment and to withstand seismic and wind forces.

   a. Complete curb and isolation assembly shall be stamped by a Professional Engineer licensed in the jurisdiction of the project certifying capacity to resist wind loads.
   b. Provide sloped and/or extended height curb assemblies as necessary to coordinate with roof slope and buildup.

2. Sheet Metal Restraint/Spring Isolation Curbs: Upper frame shall consist of extruded aluminum or galvanized steel top rail, shall provide continuous support for equipment, and shall be captive to resiliently resist seismic and wind forces. Lower support assembly to be constructed out of formed heavy gauge sheet metal, shall have means for attaching to building structure, contain a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly. Isolation curb shall be type VCR as manufactured by Vibro-Acoustics, Model

KSCR as manufactured by Kinetics Noise Control or Model CMAB by Mason Industries, CPC-4+VIR by Curbs Plus or comparable acceptable product.

3. Structural Steel Restraint/Spring Isolation Curbs: Upper frame shall consist of a structural steel C channel to provide continuous support for the equipment and provide a place of attachment to the equipment. The lower frame shall be constructed from structural steel and shall provide adequate support to resist seismic and wind loads. The springs shall be adjustable, restrained with ¼-inch-(6-mm) thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof. Structural steel isolation curb shall be model ESR as manufactured by Kinetics Noise Control or comparable acceptable product.

   a. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic/wind restraint.
      1) Housing: Steel with resilient vertical-limit stops and a adjustable equipment mounting and leveling bolt.
      2) Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
      3) Minimum Additional Travel: 50 percent of the required deflection at rated load.
      4) Lateral Stiffness: More than 80 percent of rated vertical stiffness.
      5) Overload Capacity: Support 150 percent of rated load, fully compressed, without deformation or failure.
   b. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a non-slip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
      1) Resilient Material: Oil and water-resistant hermetically sealed compressed fiberglass.
   c. Snubber Bushings: All-directional, elastomeric snubber bushings at least ¼ inch thick.
   d. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counter flashed over roof materials.
   e. Extend height of curb as necessary to allow for spring isolator access after roof buildup is installed.

2.6 RESILIENT PENETRATION SLEEVE/SEAL

A. Unit RPS-A (Resilient Penetration Sleeve/Seal)

1. Split wall seals shall consist of two bolted pipe halves with minimum 3/4” thick neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Seals shall project a minimum of 1” past each face of the wall. Other resilient media may be substituted as required to handle higher temperatures, as approved by Sleeve/Seal manufacturer. Seals shall be type SWS as manufactured by Mason Industries or a comparable acceptable product.

2.7 SEISMIC SNUBBER

A. For equipment base: All-directional seismic snubbers shall consist of interlocking steel members restrained by a one-piece molded neoprene bushing of bridge bearing neoprene. Bushing shall be replaceable and a minimum of 1/4" thick. Rated loadings shall not exceed 1000 psi. A minimum air gap of 1/8" shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Neoprene bushings shall be rotated to insure no short circuits exist before systems are activated. Snubber shall be type SS as manufactured by Vibro-Acoustics, Model HS-5 as manufactured by Kinetics Noise Control or type Z-1225 as manufactured by Mason Industries, Inc., or comparable acceptable product.

B. For equipment direct connection: All directional seismic snubbers shall consist of interlocking steel members restrained by shock absorbent rubber materials compounded to bridge bearing specifications. Elastomeric materials shall be replaceable and a minimum of 3/4" thick. Rated loadings shall not exceed 1000 psi. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8" not more than ¼”. Snubbers shall be installed with factory set clearances. The capacity of the seismic snubber at 3/8" deflection shall be equal or greater than the load assigned to the mounting grouping controlled by the snubber multiplied by the applicable “G” force. Submittals shall include the load deflection curves up to 1/2" deflection in the x, y and z planes. Snubbers shall be type SRB as manufactured by Vibro-Acoustics, Model HS-5 as manufactured by Kinetics Noise Control or type Z-1011 as manufactured by Mason Industries, Inc., or comparable acceptable product.

2.8 FLEXIBLE DUCT CONNECTIONS

A. Flexible duct connections shall be fabricated from Neoprene, loaded vinyl or canvas. Clear space between connected parts shall be a minimum of three inches and connection shall have 1.5" minimum of slack material.

2.9 FLEXIBLE ELECTRICAL CONNECTION

A. Unit FEC-A (Flexible Electrical Connection Type A):

1. Flexible electrical coupling shall be prefabricated units incorporating flexible watertight outer jacket, grounding strap, plastic inner sleeve to maintain smooth wire way and end hubs with standard tapered electrical threads to fit standard threaded, rigid metal conduit.
2. Unit FEC-A shall be as specified in section “Raceways and Boxes for Electrical Systems” for liquid tight flexible metal conduit.

B. Unit FEC-B (Flexible Electrical Connection Type B):

1. Flexible electrical couplings shall be field-fabricated using minimum 2 ft length of flexible conduit or cable installed in grossly slack "U" shape.
2. Unite FEC-B shall be as specified in section “Raceways and Boxes for Electrical Systems” for flexible metal conduit.

2.10 THRUST RESTRAINTS

A. Thrust Restraint

1. Thrust restraints shall consist of spring element in series with Neoprene pad.
2. Thrust restraint shall be designed to have same deflection as specified for isolators supporting equipment generating thrust.
3. Spring element shall be contained within steel frame and be designed to be factory-preset for thrust and be field-adjustable to allow for maximum of 1/4" movement during starting or stopping of equipment.
4. Furnish assembly complete with rods and angle brackets for attachment to both equipment generating thrust and adjacent fixed structural anchor.
5. Thrust restraint shall be type AHCS or HCS as manufactured by Vibro-Acoustics, Model HSR as manufactured by Kinetics Noise Control or Mason Industries Type WB, or comparable acceptable product.

2.11 GROMMETS

A. Grommets shall be one piece molded bridge-bearing neoprene washer/bushing type. The bushing shall surround the anchor bolt and have a flat washer force to avoid all contact between bolt and base plate. Grommets shall be type GW as manufactured by Vibro-Acoustics, model HG as manufactured by Mason Industries or comparable acceptable product.

B. Neoprene shall be between 40 and 50 durometer.

C. Grommets shall be specially formed to prevent fastening bolts from directly contacting isolator base plate.

2.12 EXPANSION JOINTS / FLEXIBLE CONNECTORS

A. Rubber expansion joints shall be double sphere peroxide cured EPDM throughout (cover, liner, and cord fractioning) with Kevlar tire cord fabric reinforcement. Joints shall have raised face rubber flanges that encase solid steel retention rings. Cable/flexible reinforcement is not acceptable. Split flanges shall interlock and include a pivot fulcrum to increase clamp load at the sealing face. Sizes 1-1/2” through 24” shall have a reinforcing ring molded in between the spheres. Safety factor shall be a minimum of 3 to 1. All joints must be factory tested to 150% of maximum pressure for 4 minutes prior to shipping.

B. Sizes ¾” through 2” shall be single sphere, with bolt-on flanges and shall be model SFU as manufactured by Mason Industries, Inc.

C. Sizes 1-1/2” through 24” shall be model SFDEJ as manufactured by Mason Industries, Inc. Reducing versions of the specified models are required when available.

2.13 ACOUSTICAL SEALANT

A. Sealants for acoustical purposes shall be one of following non-setting sealants:

1. Acoustical sealant ..... D.A.P.
2. BR-96 ..... Pecora
3. Acoustical sealant ..... Tremco
4. Acoustical sealant ..... U.S.G.

2.14 VIBRATION ISOLATION SCHEDULE

			Slab on Grade			Up to 30 Ft. Floor Span			Greater Than 30' Floor Span			
Fans (Not Within Equipment)	**Horsepower/ Other**	**RPM**	**Base Type***	**Isolator Type**	**Minimum Deflection IN.**	**Base Type***	**Isolator Type**	**Minimum Deflection IN.**	**Base Type***	**Isolator Type**	**Minimum Deflection IN.**	**Component Importance Factor**
Inline Centrifugal, Cabinet, Ceiling	All	All	N/A	3	0.75	N/A	3	1.50	N/A	3	1.50	

*If fan is suspended, no base is required. Attach isolators directly to equipment.

[1]Utilize Type B for ≤ 2 in. SP. Utilize Type C for ≥ 2.1 in. SP.

[2]Utilize Type 3 for indoor installations. Utilize Type 4 for outdoor installations.

			Slab on Grade			Up to 30 Ft. Floor Span			Greater Than 30' Floor Span			
Miscellaneous Equipment	**Horsepower/ Other**	**RPM**	**Base Type**	**Isolator Type**	**Minimum Deflection, IN.**	**Base Type**	**Isolator Type**	**Minimum Deflection, IN.**	**Base Type**	**Isolator Type**	**Minimum Deflection IN.**	**Component Importance Factor**
Heat Pumps, Fan Coil Units, Computer Room units, A/C Units, Condensing Units, other miscellaneous Motor Driven Equipment	All	All	N/A	3/4[2]	0.75	N/A	3/4[2]	0.75	N/A	3/4[2]	1.50	

[2]Utilize Type 3 for indoor installations. Utilize Type 4 for outdoor installations.

			Slab on Grade			Up to 30 Ft. Floor Span			Greater Than 30' Floor Span			
Packaged AHUs, RTUs, ERVs, HRUs, HVUs, Etc.	**Horsepower/ Other**	**RPM**	**Base Type**	**Isolator Type**	**Minimum Deflection, IN.**	**Base Type**	**Isolator Type**	**Minimum Deflection, IN.**	**Base Type**	**Isolator Type**	**Minimum Deflection IN.**	**Component Importance Factor**
No Curb, Indoors	All	All	N/A	3	0.75	N/A	3	1.50	N/A	3	*	
No Curb, Outdoors	All	All	N/A	4	0.75	N/A	4	1.50	N/A	4	*	
Curb Mounted	All`	All	D	3	0.75	D	3	1.50	D	3	*	

The following note applies to all equipment types listed in Tables before and hereinafter:

*Additional floor deflection caused by the equipment must be first determined prior to examining minimum isolation deflection. If additional floor deflection is 0.25" or less, deflection equal 10 times the deflection is to be chosen. If additional floor deflection is greater than 0.25", floor stiffening must be added and/or the unit must be moved to a stiffer area of the floor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install isolation for motor-driven equipment.

B. Make equipment level.

C. Install spring hangers without binding.

D. Isolators:

1. Closed Spring Isolators: Adjust such that side stabilizers are clear under normal operating conditions.
2. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height; when full load is applied, adjust isolators to load to allow shim removal.

E. Provide pairs of horizontal limit springs on fans with more than 6.0 inches of static pressure and on hanger-supported, horizontally mounted axial fans.

F. Snubbers:

1. Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers.
2. Provide each inertia base with minimum of four seismic snubbers located close to isolators.
3. Equipment Designated for Post-Disaster: Snub to 0.05-inch maximum clearance.
4. Other Snubbers: Provide clearance between 0.15 and 0.25 inch

G. Support piping connections to isolated equipment resiliently as follows:

1. Up to 4-Inch diameter: First three points of support.
2. 5- to 8-Inch diameter: First four points of support.
3. Support all piping in equipment rooms and minimum 50 fifty feet from vibration isolated equipment and PRV stations. The first 3 hangers from the equipment shall have same deflection as the equipment isolators. The remaining hangers shall have 0.75 inch deflection.

3.2 FIELD QUALITY CONTROL

A. Division 01 - Quality Requirements: Requirements for inspecting and testing.

B. Inspect isolated equipment after installation and submit report, including static deflections.

3.3 EXAMINATION

A. Division 01 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that equipment, ductwork, and piping are installed before starting Work of this Section.

3.4 INSTALLATION OF SEISMIC CONTROLS

A. General: Comply with MSS SP-69, “Pipe Hangers and Supports C Selection and Application,” “latest edition”, and SP-89, “Pipe Hangers and Supports -- Fabrication and Installation Practices,” “latest edition”. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. Piping shall be supported independently from equipment connections. Supports shall not interfere with removal of equipment.

1. At locations where cable assemblies’ restraints are located, the support rods must be braced when necessary to accept compressive loads.
2. At all locations where cable assemblies’ restraints are attached to pipe clevis’s, the clevis cross bolt must be reinforced.

B. Seismic restraints, shall be provided for all installed mechanical equipment having a component importance factor of 1.5 where the Seismic Design Category is C or importance factor of 1.0 where the Seismic Design Category is D, E, or F.

C. Installation of vibration isolators and seismic restraints must not cause any change of position of equipment or piping resulting in stresses or misalignment.

D. Vibration isolated seismic restraints.

1. The contractor shall not install seismic restraints which make rigid connections with the building on vibration isolated equipment and systems.

2. Any conflicts with other trades which will result in rigid contact with equipment ductwork, or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

   a. Cable restraints shall be installed slightly slack to avoid short circuiting the vibration isolated suspended equipment, piping or conduit.
   b. Cable assemblies are installed taut on non-vibration isolation systems. Seismic solid braces may be used in place of cables on rigidly attached systems only, but cable restraints are the preferred method of installation. Hose fittings and accessories shall be unbraided type 304 stainless steel with a minimum bend radius of 4 inches, fittings and accessories shall be UL 2443 listed for sprinkler services to 175 psi.
   c. Restraints shall have a positive connection to the building structure. Connections made to drywall or other nonbuilding structure are not acceptable.

E. Seismic restraints for non-vibration isolated systems:

1. At locations where specification paragraphs 2.3. A or B restraints are located, the support rods must be braced when necessary to accept compressive loads with specification paragraph 2.3-C. braces.

3.5 INSTALLATION OF VIBRATION ISOLATION CONTROLS

A. General

1. Locations of vibration isolation equipment shall be selected for ease of inspection and adjustment as well as for proper operation.
2. Installation of vibration isolation equipment shall be in accordance with manufacturer's written instructions.
3. Any conflicts with other trades which will result in rigid contact with equipment, ductwork, or piping due to inadequate space or other unforeseen conditions should be brought to the Architect/Engineer's attention prior to the installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

B. Isolation Mounts

1. Squarely align vibration isolators above or below mounting points of supported equipment.

2. Isolators for equipment with bases shall be located on sides of bases, which are parallel to equipment shaft unless this is not possible because of physical constraints.
3. If housekeeping pad is provided, isolators shall bear on housekeeping pad and isolator base plate shall rest entirely on pad. Maintain at least ten bolt diameters from isolator anchors to edge of pad.
4. Hanger rods for vibration isolated support shall be connected to structural beams, joists, or slabs. Provide intermediate support members as necessary.
5. Position vibration isolation hanger elements as high as possible in hanger rod assembly but not in contact with building structure, and so that hanger housing may rotate full 360 degrees about rod axis without contacting any object.
6. Parallel-running pipes may be hung together on trapeze, which is isolated from building. Isolator deflections must be largest determined by provisions for pipe isolation. Do not mix isolated and non-isolated pipes on same trapeze.
7. No pipes or equipment shall be supported from other pipes or equipment.
8. Vibration isolated pipes shall not contact rigid building structure or equipment.
9. Installed and operating heights of vibration-isolated equipment mounted on Unit FSN isolators shall be identical. Limit stops shall be out of contact during normal operation.
10. Adjust leveling bolts and hanger rod bolts so isolated equipment is level and in proper alignment with connecting ducts or pipes.

C. Bases

1. No equipment unit shall bear directly on vibration isolators unless its own frame is suitably rigid to span between isolators and such direct support is approved by equipment manufacturer. This provision shall apply whether or not base frame is specified or indicated on drawings. If base frame is required for unit because of equipment manufacturer's requirements and is not specifically called for, base frame recommended by equipment manufacturer shall be provided at no additional expense.
2. Unless otherwise indicated, provide minimum operating clearance of 1.5" between inertia bases or structural steel frames and concrete housekeeping pad on floor beneath equipment. Position isolator mounting brackets so that required clearance is maintained. Check clearance space to ensure that no construction debris has been left to short-circuit or restrict proper operation of vibration isolation system.

D. Flexible Duct Connections

1. Sheet metal ducts or plenum openings shall be squarely aligned with fan discharge, fan intake or adjacent duct section prior to installation of flexible connection, so that clear length is approximately equal all way around perimeter. Flexible duct connections shall not be installed until this provision is met.
2. Fan or adjacent duct section shall be able to move 1" in any direction without causing metal to metal contact or stretching flexible connection taut.

E. Thrust Restraints

1. Attach thrust restraints at centerline of thrust and symmetrically on each side of equipment generating thrust for fans with a static pressure of 2” water column or more.
2. Adjust restraints to limit equipment movement to specified limit.

F. Resilient Penetration Sleeve/Seals

1. Penetration seals shall maintain airtight seal around penetrating element and shall prevent contact of penetrating element and building structure. Fit sleeve tightly to

building construction and with acoustical sealant seal airtight on both sides of construction penetrated.

3.6 SEISMIC RESTRAINT OF PIPING

A. Transverse piping restraints shall be at 40’ maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads. Spacing shall be reduced to 20’ maximum spacing for piping containing hazardous/flammable materials and/or built from nonductile materials such as cast iron and PVC. Minimum of two transverse restraints are required per pipe run.

B. Longitudinal restraints shall be at 80' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads. Spacing shall be reduced to 40’ maximum spacing for piping containing hazardous/flammable materials and/or built from nonductile materials such as cast iron and PVC. Minimum of one longitudinal restraint is required per pipe run.

C. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.

D. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24" of the elbow or TEE or combined stresses are within allowable limits at longer distances.

E. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.

F. Branch lines may not be used to restrain main lines.

3.7 SEISMIC RESTRAINT OF DUCTWORK

A. Transverse restraints shall occur at 30’ intervals or at both ends of the duct run if less than the specified interval. Minimum of two transverse restraints are required per duct run.

B. Longitudinal restraints shall occur at 60’ intervals with at least one restraint per duct run. Minimum of one longitudinal restraint is required per duct run.

C. Restraint spacing and capacity shall be per current code requirements and exemptions. Any exemptions mentioned herein are subject to current code requirements and acceptance of AHJ.

D. Ductwork shall be reinforced at the restraint locations. Rectangular duct shall have steel angle/strut on top of the duct work at trapeze locations. Fasten duct to both the trapeze and the addition reinforcement member.

E. Where multiple ducts share a common support the combined weights/dimensions shall determine the need or seismic restraint.

F. Walls, including gypsum wall board partitions, may replace a transvers brace when detailed and rated for the load.

G. Friction connection type (c-clamp style) supports are not allowed.

H. Isolation hanger locations where seismic restraints are attached shall have type RW Rebound Washers.

3.8 SEISMIC RESTRAINT EXCLUSIONS

A. Pipe Exclusions

1. Any exclusions/exemptions to seismic restraint requirements described in the building code and as approved by the AHJ are acceptable.

3.9 APPLICATIONS FOR VIBRATION CONTROLS

A. Major Equipment

1. Unless otherwise shown or specified, major floor-mounted equipment shall be set on housekeeping type concrete pads. See architectural or structural drawings for details.
2. Flexible duct connections shall be installed at fan unit intakes, fan unit discharges, and wherever else shown on drawings.
3. Electrical connections to vibration-isolated equipment exposed to weather shall be unit FEC-A.
4. Electrical connections to vibration-isolated equipment located indoors shall be unit FEC-B.
5. Thrust Restraints shall be installed on equipment as called for in schedule on drawings or specified hereunder.

B. Miscellaneous Mechanical Equipment

1. Miscellaneous pieces of mechanical equipment such as heat exchangers, pressure reducing stations, domestic water heaters, storage tanks, condensate receiver tanks and expansion tanks shall be vibration-isolated from building structure by Unit FN isolators unless their position in piping system requires higher degrees of isolation as called for under pipe isolation requirements.

C. Pipes

1. Isolators for first three support points adjacent to connected equipment shall achieve half of specified static deflection of isolators supporting connected equipment. When required static deflection of these pipe isolators is greater than 0.50," Unit FSN or HSN isolators, (whichever is applicable for mounting condition) shall be used.
2. Where lateral support of pipe risers is required within specified limits, use resilient lateral supports.
3. Pipes within specified limits that penetrate building construction shall be isolated from building structure by (Unit RPS-A or Unit RPS-B) resilient penetrating sleeve/seals.

3.10 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Adjust for pipe alignment and final equipment connections. Flexible connections shall not be used for adjustment of alignment.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, and the other sections of Division 23.

1.2 SUMMARY:

A. Section Includes:

1. Engraved Plastic-Laminate Signs.
2. Valve Tags.
3. Painted Identification Materials
4. Plastic Pipe Markers.
5. Ceiling Tacks
6. Plasticized Tags.
7. Duct Markers.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 09 Section: “Painting and Coating”: Execution requirements for painting specified by this section.
2. Division 23 Section: “Common Work Results for HVAC.”
3. Division 23 Section: “Refrigerant Piping.”
4. Division 23 Section: “Facility Fuel Oil Pumps.”
5. Division 23 Section: “HVAC Air Distribution.”
6. Division 23 Section: “HVAC Fans.”

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”)

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.4 SUBMITTALS

A. Division 01 Section – “Submittal Procedures”: Submittal Procedures.

B. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

E. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8 1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. Furnish copies for Maintenance Manuals as specified in Division 01 Section: “Execution and Closeout Requirements.”

F. Maintenance Data: Include product data and schedules in maintenance manuals, in accordance with requirements of Division 01.

G. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

H. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

I. Comply with VOC limitations under section 099100.

J. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.5 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1, for lettering size, length of color field, colors, and viewing angles of identification devices.

C. Equipment Lettering and Graphics:

1. General: Coordinate names, abbreviations and other designations used in HVAC identification work, with corresponding designations shown, specified or scheduled.

Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of HVAC systems and equipment.

a. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification, which indicates individual system number as well as service (for example; Unit Heater No. 3).

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 EXTRA MATERIALS

A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two containers of spray-on adhesive.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering identification materials which may be incorporated in the work include, but are not limited to, the following:

1. Brady (W.H.) Co.; Signmark Div.
2. Industrial Safety Supply Co., Inc.
3. Seton Name Plate Corp.

2.2 MATERIALS:

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections. Where more than single type is specified for application, selections is Installer's option, but provide single selection for each product category.

B. Provide pipe markers with the following background colors and designations:

SERVICE	STENCIL DESIGNATION	LETTER COLOR	BACKGROUND COLOR	JACKET
Refrigerated Suction	Refrigerant Suction	Black	Safety Orange	Black
Refrigerated Liquid	Refrigerant Liquid	Black	Safety Orange	Black

2.3 ENGRAVED PLASTIC-LAMINATE SIGNS (Nameplates):

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/8", except as otherwise indicated.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

D. Nomenclature: Include the following, matching terminology on schedules as closely as possible:

1. Name and plan number.
2. Equipment service.
3. Design capacity.
4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.

E. Size: Provide approximate 2 1/2" x 4" markers for control devices, dampers, and valves; and 4 1/2" x 6" for equipment.

2.4 VALVE TAGS:

A. Metal Tags:

1. Brass with stamped letters; tag size minimum 1-1/2 inches square with finished edges.

B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

C. Tag Chart: Typewritten letter size list of applied tags and location in anodized aluminum frame

2.5 PAINTED IDENTIFICATION MATERIALS:

A. Stencils: With clean cut symbols and letters of following size:

1. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2 inch high letters.
2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
3. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
4. Ductwork and Equipment: 1-3/4 inches high letters.

B. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

C. Identification Paint and Background Color; Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems and HVAC equipment comply with ANSI A13.1 for colors. For ductwork, use green paint. For hazardous exhaust, use colors per ANSI A13.1.

2.6 PLASTIC PIPE MARKERS:

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, UV-resistant color-coded pipe markers, complying with ANSI/ASME A13.1

B. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1 1/2".

C. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:

1. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1 1/2" wide; full circle at both ends of pipe marker, tape lapped 3".
2. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

D. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length. Operating pressure of steam systems shall be indicated.

1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.

2.7 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color-coded head.

B. Color code as follows:

1. HVAC equipment: Yellow.
2. Fire dampers: Red.
3. Plumbing valves: Green.
4. Heating/cooling valves: Blue.

2.8 PLASTICIZED TAGS:

A. General: Manufacturer's standard pre-printed or partially pre- printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3 1/4" x 5 5/8", with brass grommets and wire fasteners, and with appropriate pre- printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.9 DUCT MARKERS:

A. Identify air: supply, return, exhaust, intake and relief ducts with duct markers or provide stenciled signs and arrows showing service and direction of air flow.

1. Locate signs near points where ducts enter into concealed spaces and at maximum intervals of 25 feet.
2. Provide identification labels at access panels to locate concealed duct accessories.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Division 09 Section: “Painting and Coating”

3.2 INSTALLATION:

A. General:

1. Coordination: Where identification is to be applied to surfaces, which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

2. Confined Spaces: Provide labels and signs on all duct and equipment doors, plenums, etc. to indicate service and provide operator warnings as required by OSHA, NFPA, and authority having jurisdiction.

B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

D. Piping System Identification:

1. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:

   a. Plastic pipe markers, with application system as indicated under "Materials" in this section.
2. Locate pipe markers and color bands as follows on all piping in occupied spaces, above ceilings, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

   a. Near each valve and control device.
   b. Near each branch, excluding short take-offs for equipment and terminal units; mark each pipe at branch, where there could be question of flow pattern.
   c. Near locations where pipes pass through walls or floors/ ceilings, or enter non-accessible enclosures.
   d. At access doors, manholes and similar access points, which permit view of concealed piping.
   e. Near major equipment items and other points of origination and termination.
   f. Spaced intermediately at maximum spacing of 25' along each piping run, except reduce spacing to 10' in congested areas.

E. Valve Identification:

1. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, and shut-off valves at HVAC equipment. List each tagged valve in valve schedule for each piping system.

F. Equipment Identification:

1. General: Install engraved plastic laminate sign on or near each major item of HVAC equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

   a. Main control and operating valves, including safety devices and hazardous units.
   b. Pumps, compressors, and similar motor- driven units.
   c. Tanks and pressure vessels.
2. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.

3. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety precautions, and warn of hazards and improper operations.

G. Identify air handling units, and pumps with plastic nameplates.

H. Identify control panels and major control components outside panels with plastic nameplates.

I. Identify air terminal units with numbered tags.

J. Tag automatic controls, instruments, and relays. Key to control schematic.

K. Apply stencil painting in accordance with Division 09 Section: “Painting and Coating”

L. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

M. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.3 ADJUSTING:

A. Adjusting: Relocate any identification device, which has become visually blocked by work of this division or other divisions.

3.4 CLEANING:

A. Cleaning: Clean face of identification devices.

3.5 EXTRA STOCK:

A. Furnish minimum of 5% extra stock of each identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including the General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other Sections of Division 22.

1.2 SUMMARY

A. Coordinate work of this section with all trades.

B. Work covered in this Section shall be performed after completion of work specified in all Divisions as they related to this work.

C. Review of design drawings and specifications, and comment on potential problem areas.

D. Site inspections of ongoing plumbing installation with written report from each visit.

E. Air leak testing of ductwork system. See Division 23 Section: “HVAC Air Distribution.”

F. Section Includes:

1. Testing adjusting, and balancing of air systems.
2. Testing adjusting, and balancing of refrigerating systems.
3. Measurement of final operating condition of HVAC systems.
4. Sound measurement of equipment operating conditions.
5. Vibration measurement of equipment operating conditions.

G. Coordinate with all trades to provide all incidental items not indicated on drawings or in specifications that belong to work described or are required for complete systems balancing, at no additional cost to Owner.

H. Related Sections: The following sections contain requirements that relate to this section:

1. Division 23 Section: “Instrumentation and Control for HVAC”: Requirements for coordination between DDC System and Testing, Adjusting, and Balancing, and Sequences of operation.
2. Division 23 Section: “Common Work Results for HVAC”: Execution Requirements, Closeout Requirements.
3. Division 01 Section: “Commissioning”.

1.3 REFERENCES

A. Associated Air Balance Council:

1. AABC MN-1-National Standards for Testing and Balancing, Heating, Ventilating, and Air Conditioning Systems.

B. American Society of Heating Refrigerating and Air-Conditioning Engineers:

1. ASHRAE Research Report No. 1162, Air Flow Measurements at Intake and Discharge Openings and Grilles, ASHVE Transactions, Volume 46.
2. ASHRAE Handbook of Fundamentals.
3. ASHRAE Standard 70 (RA 2011), Method of Testing the Performance of Air Outlets and Air Inlets.
4. ASHRAE 111 – Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

C. Natural Environmental Balancing Bureau:

1. NEBB – Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
2. ANSI S1.4 - -Specification for Sound Level Meters.
3. ANSI S1.11 – Specification for Octave, Half Octave, and Third Octave Bond Filter Sets.
4. ANSI S1.13 – Measurement of Sound Pressure Levels in Air.
5. ANSI S1.40 – Verification Procedures for Sound Calibration.

D. Testing Adjusting and Balancing Bureau:

1. TABB – International Standards for Environmental Systems Balance.

E. Sheet Metal and Air Conditioning Contractors National Association Inc.:

1. (SMACNA) – Air Duct Leakage Test Manual.

F. National Institute of Standards and Technology:

1. NIST

1.4 SUBMITTALS

A. Division 01 Section: “Submittal Procedures”: Submittal Procedures.

B. Agency Data:

1. Submit proof that proposed testing, adjusting, and balancing agency meets the qualifications specified within 30 days of award of contract.

C. Engineer and Technicians Data:

1. Submit proof that Test and Balance Engineer assigned to supervise procedures, and technicians proposed to perform procedures meet qualifications specified within 30 days of award of contract.

D. Procedures and Agenda: Submit synopsis of testing, adjusting, and balancing procedures and agenda proposed to be used for this project within 90 days of award of contract.

1. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms, and copy of AABC National Project Performance Guaranty, NEBB Certificate of Conformance Certification, or TABB International Quality Assurance program guarantee.

E. Document Review:

1. Submit certification in writing that all design drawings and specifications have been reviewed, and comment on potential problems within 90 days of award of contract.

F. Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems. Include this information in maintenance data specified in Division 01 and Division 23 Section: “Common Work Results for HVAC.”

G. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of Test and Balance Engineer. Reports shall be certified proof that systems have been tested, adjusted, and balanced in accordance with referenced standards; are an accurate representation of how systems have been installed; are true representation of how systems are operating at completion of testing, adjusting, and balancing procedures; and are accurate record of final quantities measured, to establish normal operating values of the systems. Follow procedures and format specified below:

1. Report Format: Report forms shall be those standard forms prepared by referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with project identification and a title descriptive of contents. Divide contents of binder into divisions listed below, separated by divider tabs:

a. General Information and Summary
b. Air Systems
c. Automatic Temperature Controls
d. Special Systems
e. Sound and Vibration Systems

2. Report Contents: Provide following minimum information, forms and data:

a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project. Include addresses, and contact names and telephone numbers. Include certification sheet containing seal and name address, telephone number, and signature of Certified Test and Balance Engineer. Include in this division listing of the instrumentations used for the procedures along with proof of calibration.
b. Remainder of the report shall contain appropriate forms containing as minimum, information indicated on standard report forms prepared by AABC and NEBB, for each respective item and system. Prepare schematic diagram for each item of equipment and system to accompany each respective report form.

H. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

I. NIST Calibration Reports: Submit proof that all testing and balancing instruments and equipment used for this project has been calibrated in accordance with NIST Standards, within period of twelve months prior to starting project.

J. Submit draft copies of report for review prior to final acceptance of Project.

K. Furnish reports complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

L. Final submittal shall include but not be limited to following:

1. List of equipment used to perform test and procedures.
2. Equipment performance data and equipment curves with actual points of performance indicated on curves as compiled during balancing.
3. Air Devices including (supply, return and exhaust) all air outlets.
4. Duct traverse readings during balancing.
5. Room sound pressure levels.
6. Domestic hot water components flow rates, pressures and temperatures.
7. On balance report documents record date and time of reading.

M. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.5 CLOSEOUT SUBMITTALS

A. Division 01 Section: “Execution and Closeout Requirements”: Closeout procedures.

B. Project Record Documents: Record actual locations of flow measuring stations, balancing valves, and rough setting.

C. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with Authority Having Jurisdiction requirements.

B. Agency Qualifications:

1. Employ services of independent testing, adjusting, and balancing agency meeting qualifications specified below, to be single source of responsibility to test, adjust, and balance the building heating, ventilating and air conditioning systems to produce design objectives. Services shall include checking installations for conformity to design, measurement and establishment of fluid quantities of mechanical systems as required to meet design specifications, and recording and reporting results.
2. Certified by National Environmental Balancing Bureau (NEBB) or by Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in State in which services are to be performed, certified by NEBB or AABC as Test and Balance Engineer.

C. Work shall be accomplished in accordance with specifications. Procedures specified shall be followed and, if not specifically described herein, in general, shall be in accordance with Associated Air Balance Council's National Standards or National Environmental Balancing Bureau's Procedural Standards.

D. Design Review:

1. Review all design drawings and specifications. Review shall include:

   a. Duct pressure classification.
   b. Control device location and balancing devices location in duct systems and piping systems.
   c. Indicate additional balancing devices required for proper balancing.
   d. Specifications on all devices required for balancing.
   e. Note any potential noise problems.

2. Within 90 days of award of contract, meet with the Architect, Mechanical Contractor, and Building Automation System Contractor to review procedures and agenda and comments on design documents as to potential problem areas.

E. Shop Drawing Review:

1. Review “Instrumentation and Control for HVAC” shop drawing submittals noting any potential balancing problems. Note comments on submittal, sign, stamp and return to General Contractor. All “Instrumentation and Control for HVAC” submittals must be reviewed by balancing agency prior to review by Architect.

F. Pre-Balancing Conference: Prior to beginning of testing, adjusting, and balancing procedures, schedule and conduct conference with Architect and representatives of installers of mechanical systems. Objective of conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

G. During construction, balancing agency shall inspect the installation of pipe systems, temperature controls, and other component parts of heating, ventilating, and air conditioning systems. Inspections shall be performed periodically as work progresses. Minimum of two inspections are required as follows: (1) when 60 percent of ductwork is installed; (2) when 90 percent of equipment is installed. Balancing agency shall submit brief written report of each inspection to Owner and Architect.

1.7 QUALIFICATIONS

A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum five years’ experience certified by AABC, NEBB, or TABB.

1.8 PRE-INSTALLATION MEETINGS

A. Division 01 Section: “Administrative Requirements”: Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.9 SEQUENCING

A. Divison 01 Section: "Summary Of Work" : Work sequence.

B. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.10 SCHEDULING

A. Division 01 Section: "Administrative Requirements": Coordination and project conditions.

B. Schedule and provide assistance in final adjustment and test of life safety, smoke evacuation, or smoke control system with Fire Authority.

1.11 OWNER'S INSTRUCTIONS

A. Balancing contractor's technician along with his balancing engineer shall provide four (4) hours of instruction to Owner's engineers on balancing methods, procedures and equipment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section: "Administrative Requirements": Coordination and project conditions.

B. Preliminary Work:

1. Inspect project site prior to starting adjustments to verify completion of trades, including general construction, piping system, ductwork system, building automation systems, and electrical systems, as they relate to balancing work. Verify systems are complete and operable before commencing work. Verification shall include but not be limited to following:

    a. Systems are started and operating in safe and normal condition.

    b. Ductwork System:
        1) Duct joints sealed.
        2) Witness leakage tests required under sheet metal section.
        3) Dampers and control devices installed.
        4) Duct systems are clean of debris.
        5) Fire and volume dampers are in place and open

    c. Proper direction of rotation for motor-driven equipment and for proper speed on multi-speed motors.
        1) Fans are rotating correctly.
        2) Pumps are rotating correctly.

d. Balancing devices are installed and accessible.

e. Control device connections.
   1) HVAC control systems are installed complete and operable.

f. Note problems in general construction of the building that might effect systems performance such as sealing of windows, building joints, exhaust shafts, etc.

g. Problems discovered during this inspection shall be reported to General Contractor and Owner.

h. Proper thermal overload protection is in place for electrical equipment.

i. Final filters are clean and in place. If required, install temporary media in addition to final filters.

j. Air coil fins are cleaned and combed.

k. Access doors are closed and duct end caps are in place.

l. Air outlets are installed and connected.

2. Contractor shall certify in writing that each piping system has been prepared as per this Section, indicating dates procedures were done and which contractor did work. Submit in writing to Architect before beginning balancing work.

3.2 PREPARATION

A. Furnish instruments required for testing, adjusting, and balancing operations.

B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 10 percent of design.

B. Air Outlets and Inlets: Adjust total to within plus or minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 5 percent of design.

3.4 ADJUSTING

A. Division 01 Section: “Execution and Closeout Requirements”: Testing, adjusting, and balancing.

B. Verify recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

E. Report defects and deficiencies noted during performance of services, preventing system balance.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.

H. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 SYSTEM BALANCE - GENERAL REQUIREMENTS

A. Balance heating, ventilating, and air conditioning to obtain air quantities indicated and required for proper operation of system.

B. Field work performed under this Section shall be provided under direct supervision of a Registered Professional Engineer.

C. Furnish services for complete adjustment of water systems, steam systems and air handling and exhaust systems, and air distribution and controls.

D. During all tests, it shall be demonstrated that systems shall be free from leaks and all parts of system will operate correctly. If not, report deficiencies to Contractor and Owner. Balancing Firm shall make final adjustments to equipment as may be required for proper operation, maintaining correct temperatures in all parts of the building. Controls shall be adjusted by “Instrumentation and Control for HVAC” technicians in conjunction with Balancing Firm. Coordinate setpoints and adjustments with “Instrumentation and Control for HVAC.”

E. Balancing of heating and air conditioning, exhaust and ventilating systems to achieve air quantities specified at each air inlet, outlet, or damper shown on plans at proper conditions of static pressure and temperature differential.

F. Study and report on excessive noise conditions, which may develop during system balancing. Report shall be sent to Architect.

3.6 AIR SYSTEM BALANCE

A. Prior to air balance, witness duct leak tests as performed under Division 23 Section: “HVAC Air Distribution.”

B. In conjunction with Division 23 “Instrumentation and Controls for HVAC,” equipment shall be started per design sequence. Determine fan airflow at rated speed. If airflow is not within 10% of design capacity of rated speed, review system conditions, procedures, and recorded data. Check and record pressure drops across filters, compensate for clean versus dirty filters, coils, sound traps, airflow sensors, etc., to indicate excessive pressure loss or leakage. Resolve problems with appropriate contractor. If systems are properly operating, and airflow is still unacceptable, adjust fan drive in accordance with manufacturer’s recommendations to obtain

proper airflow and static pressure. Systems shall be balanced and operated at lowest feasible static pressure with allowance for filter loading. Record fan suction pressure, fan discharge pressure, amperage and airflow measurement. Correct fan curves to indicate new points of balance. Fan motor shall not be overloaded.

C. With fan systems adjusted and dampers set to handle normal minimum outdoor air, perform following tests and compile following information:

1. Air Handling Equipment:

a. Design Conditions
   1) Supply, Return and Exhaust Airflow
   2) Static and Total Pressure
   3) Outdoor Airflow
   4) Motor rating
   5) Fan speed
   6) Outlet Velocity

b. Installed Equipment
   1) Manufacturer
   2) Motor serial number
   3) Motor type and efficiency, rating, voltage, phase, full-load amperes.

c. Field Test
   1) Fan Speed
   2) No-load operating amperes
   3) Fan motor operating amperes
   4) Calculated motor output

d. Test for Total Air
   1) Sum of discharge, exhaust, return air and outside air ducts.
   2) Number and locations of velocity readings taken.
   3) Duct average velocity
   4) Total airflow

e. After completion of tests, adjustments, and balancing under minimum outdoor air conditions, set system for 100% outdoor air. Repeat the total airflow tests to check field versus design conditions. Results under 100% outdoor air cycle shall agree with conditions found under “minimum fresh air operation” before system is considered to be in balance. Adjustments of proper dampers shall be made to achieve balance.

D. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.

E. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

F. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

G. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

H. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

I. At modulating damper locations, take measurements and balance at extreme conditions.

J. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches differential static pressure near building entries.

K. With supply, return, and exhaust systems properly adjusted for airflow and static pressure, conduct following test, adjustments and compilation of data:

1. Duct Mains and Branches:

   a. Adjust, measure and record airflow, static pressure of duct mains and branch ducts to provide required pressure and airlflow terminal devices.
   b. Make air flow rate measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.

2. Terminal Devices:

   a. Manufacturer, Model No. and Size of airflow control valves (supply, return and exhaust).
   b. Inlet velocity, static pressure, minimum and maximum airflow setpoints of valves.
   c. Outlet airflow of valve.
   d. Adjust minimum or maximum setting of valves as required to obtain required airflow of outlets in accordance with manufacturer's procedures and recommendations.
   e. In conjunction with "Instrumentation and Control for HVAC", operate controls, i.e., thermostats, switches and pressure controls in accordance with design sequence to verify proper operation.
   f. Report control problems in writing to the Contractor. Resolve sequence problems with Section "Instrumentation and Control for HVAC", the Contractor and Architect at no additional cost.

3. Air Inlets and Outlets (supply, return and exhaust registers diffusers and grilles)

   a. Manufacturer, model number, size of outlet and number of throw directions.
   b. Design and actual airflow.
   c. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
   d. Adjust general HVAC systems to design airflow within the following tolerances:
      1) Total system supply, return, and exhaust: (design to plus 10 percent).
      2) Outdoor air: (minus 5 percent to plus 5 percent).
      3) Total supply, return, and exhaust for a room or space: (minus 5 percent to plus 5 percent).
      4) Grilles, registers, and diffusers:
         a) One per room or space: (minus 5 percent to plus 5 percent).
         b) Two or more per room or space: (minus 10 percent to plus 10 percent).
   e. Adjust direction of throw as required to match final installation location to prevent drafts.
   f. With supply, return and exhaust balanced to design airflow, report room pressurization, (positive or negative). Report pressure readings relative to adjacent spaces only where requested by Owner or Architect.

L. Sheaves And Belts:

1. Should the air balance not meet acceptable industry standard tolerances as referenced herein, change and replace sheaves and belts to provide a final acceptable air balance. Replacement of sheaves and belts shall be provided at no additional cost.

M. Airflow Measuring Stations

1. Airflow Measuring Stations shall be field calibrated.

3.7 ACOUSTICS AND NOISE CRITERIA

A. Verify that mechanical systems comply with noise criteria as specified and indicated in Division 23. Where compliance is questionable or where additional testing requested by Owner, Architect or Contractor, take sound pressure level reading and record. Diagnose equipment causing deviations and report deviations to appropriate trade contractor and Contractor. Resolve noise problems with Contractor and appropriate Installer.

3.8 SOUND-LEVEL MEASUREMENTS

A. Perform sound-pressure-level measurements with an octave-band analyzer complying with ANSI S1.4 for Type 1 sound-level meters and ANSI S1.11 for octave-band filters. Comply with requirements in ANSI S1.13, unless otherwise indicated.

B. Calibrate sound meters before each day of testing. Use a calibrator provided with the sound meter complying with ANSI S1.40 and that has NIST certification.

C. Use a microphone that is suitable for the type of sound levels measured. For areas where air velocities exceed 100 fpm, use a windscreen on the microphone.

D. Perform sound-level testing after air and water balancing and equipment testing are complete.

E. Close windows and doors to the space.

F. Perform measurements when the space is not occupied and when the occupant noise level from other spaces in the building and outside are at a minimum.

G. Clear the space of temporary sound sources so unrelated disturbances will not be measured. Position testing personnel during measurements to achieve a direct line-of-sight between the sound source and the sound-level meter.

H. Take sound measurements at a height approximately 48 inches above the floor and at least 36 inches from a wall, column, and other large surface capable of altering the measurements.

I. Take sound measurements in dBA and in each of the 8 unweighted octave bands in the frequency range of 65 to 8000 Hz.

J. Take sound measurements with the HVAC systems off to establish the background sound levels and take sound measurements with the HVAC systems operating.

Calculate the difference between measurements. Apply a correction factor depending on the difference and adjust measurements.

K. Perform sound testing at 5 locations on Project for each of the following space types. For each space type tested, select a measurement location that has the greatest sound level. If testing multiple locations for each space type, select at least one location that is near and at least one location that is remote from the predominant sound source. Test sound levels after all phases of project are complete. Coordinate with Owner for selection of spaces to be tested.

1. Private offices.
2. Open office areas.
3. Conference rooms.
4. Each space with a noise criterion of RC or NC 25 or lower.
5. Each space with an indicated noise criterion of RC or NC 35 and lower that is adjacent to a mechanical equipment room or roof mounted equipment.
6. Inside each mechanical equipment room.

3.9 SCHEDULES

A. Report Forms

1. Title Page:

   a. Name of Testing, Adjusting, and Balancing Agency
   b. Address of Testing, Adjusting, and Balancing Agency
   c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
   d. Project name
   e. Project location
   f. Project Architect
   g. Project Engineer
   h. Project Contractor
   i. Project altitude
   j. Report date

2. Summary Comments:

   a. Design versus final performance
   b. Notable characteristics of system
   c. Description of systems operation sequence
   d. Summary of outdoor and exhaust flows to indicate building pressurization
   e. Nomenclature used throughout report
   f. Test conditions

3. Instrument List:

   a. Instrument
   b. Manufacturer
   c. Model number
   d. Serial number
   e. Range
   f. Calibration date

4. Electric Motors:

   a. Manufacturer

b. Model/Frame
c. HP/BHP and kW
d. Phase, voltage, amperage; nameplate, actual, no load
e. RPM
f. Service factor
g. Starter size, rating, heater elements
h. Sheave Make/Size/Bore

5. V-Belt Drive:

a. Identification/location
b. Required driven RPM
c. Driven sheave, diameter and RPM
d. Belt, size and quantity
e. Motor sheave diameter and RPM
f. Center to center distance, maximum, minimum, and actual

6. Pump Data:

a. Identification/number
b. Manufacturer
c. Size/model
d. Impeller
e. Service
f. Design flow rate, pressure drop, BHP and kW
g. Actual flow rate, pressure drop, BHP and kW
h. Discharge pressure
i. Suction pressure
j. Total operating head pressure
k. Shut off, discharge and suction pressures
l. Shut off, total head pressure

7. Air Cooled Condensing Unit:

a. Identification/number
b. Location
c. Manufacturer
d. Model number
e. Serial number
f. Entering DB air temperature, design and actual
g. Leaving DB air temperature, design and actual
h. Number of compressors

8. Air Moving Equipment:

a. Location
b. Manufacturer
c. Model number
d. Serial number
e. Arrangement/Class/Discharge

f. Air flow, specified and actual
g. Return air flow, specified and actual
h. Outside air flow, specified and actual
i. Total static pressure (total external), specified and actual
j. Inlet pressure
k. Discharge pressure
l. Sheave Make/Size/Bore
m. Number of Belts/Make/Size
n. Fan RPM

9. Return Air/Outside Air Data:

a. Identification/location
b. Design air flow
c. Actual air flow
d. Design return air flow
e. Actual return air flow
f. Design outside air flow
g. Actual outside air flow
h. Return air temperature
i. Outside air temperature
j. Required mixed air temperature
k. Actual mixed air temperature
l. Design outside/return air ratio
m. Actual outside/return air ratio

10. Exhaust Fan Data:

a. Location
b. Manufacturer
c. Model number
d. Serial number
e. Air flow, specified and actual
f. Total static pressure (total external), specified and actual
g. Inlet pressure
h. Discharge pressure
i. Sheave Make/Size/Bore
j. Number of Belts/Make/Size
k. Fan RPM

11. Duct Traverse:

a. System zone/branch
b. Duct size
c. Area
d. Design velocity
e. Design air flow
f. Test velocity
g. Test air flow
h. Duct static pressure
i. Air temperature

j. Air correction factor

12. Duct Leak Test:

a. Description of ductwork under test
b. Duct design operating pressure
c. Duct design test static pressure
d. Duct capacity, air flow
e. Maximum allowable leakage duct capacity times leak factor
f. Test apparatus
    1) Blower
    2) Orifice, tube size
    3) Orifice size
    4) Calibrated
g. Test static pressure
h. Test orifice differential pressure
i. Leakage

13. Air Monitoring Station Data:

a. Identification/location
b. System
c. Size
d. Area
e. Design velocity
f. Design air flow
g. Test velocity
h. Test air flow

14. Flow Measuring Station:

a. Identification/number
b. Location
c. Size
d. Manufacturer
e. Model number
f. Serial number
g. Design Flow rate
h. Design pressure drop
i. Actual/final pressure drop
j. Actual/final flow rate
k. Station calibrated setting

15. Air Distribution Test Sheet:

a. Air terminal number
b. Room number/location
c. Terminal type
d. Terminal size
e. Area factor

f. Design velocity
g. Design air flow
h. Test (final) velocity
i. Test (final) air flow
j. Percent of design air flow

16. Sound Level Report:

a. Location
b. Octave bands - equipment off
c. Octave bands - equipment on
d. RC level - equipment on

3.10 CALIBRATION

A. During testing and balancing, inspect temperature sensors, pressure sensors, digital indicators, and thermometers, etc. provided under Division 23. Report discrepancies to the Contractor for replacement or recalibration.

3.11 RE-BALANCE

A. After Architect's review of test and balance report submittal, make adjustment in any balancing point as required by Architect, to correct discrepancies between balance report and design, at no additional cost.

3.12 FINAL BALANCE

A. Visit site within one year after building occupancy if necessary to adjust and rebalance, any system required by Owner, to resolve any and all complaints. After final balance, revise previous submittal and resubmit to architect for record purpose. Rebalance and resubmittals shall be done at no additional cost to Owner.

3.13 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section “Commissioning”.

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable

END OF SECTION

SECTION 23 07 00
HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplemental Conditions and Division 01 Specifications, apply to this section and the other sections of Division 23.

1.2 SUMMARY

A. Section includes:

1. Insulation Materials:
    a. Cellular Glass
    b. Flexible Elastomeric
    c. Glass Mineral Wool Blanket Insulation
    d. High-Temperature, Glass Mineral Wool Blanket Insulation
    e. Glass Mineral Wool Board Insulation
    f. High-Temperature Glass Mineral Wool Board Insulation
    g. Glass Mineral Wool, Preformed Pipe Insulation
    h. Glass Mineral Wool, Pipe and Tank Insulation
    i. Polyurethane Foam Board Insulation
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied cloths.
10. Field-applied jackets.
11. Tapes.
12. Securements.
13. Corner angles.

B. Related Sections: The following sections contain requirements that relate to this section.

1. Division 07 Section: “Firestopping”: Product requirements for firestopping for placement by this section.
2. Division 09 Section: “Paints and Coatings”: Execution requirements for painting insulation jackets and covering specified by this section.
3. Division 23 Section: “Hangers and Supports for HVAC Piping and Equipment”: Product and Execution requirements for inserts at hanger locations.
4. Division 23 Section: “Identification for HVAC Piping and Equipment”: Product requirements for HVAC piping and equipment identification.

1.3 REFERENCES

(Unless otherwise noted, references apply to "latest editions.")

A. ASTM International:

1. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
3. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
4. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
5. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
6. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
7. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
8. ASTM C423 – Standard for Reverberation Room Method.
9. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
10. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
11. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
12. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
13. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
14. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
15. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
16. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
17. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
18. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
19. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
20. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
21. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
22. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
23. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
24. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
25. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
26. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.

27. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
28. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
29. ASTM C1393 - Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks .
30. ASTM C1617 – Standard Practice for Qualitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals.
31. ASTM 1622 - Standard Test Method for apparent density, apparent density, apparent overall density.
32. ATSM C1639 – Standard Specification for Fabrication of Cellular Glass Pipe and Tubing Insulation.
33. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
34. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
35. ASTM D3575 - Standard Test Methods for flexible cellular materials made from Olefin Polymers, closed cell materials, flexible cellular, Olefin Polymers, Buoyancy, etc.
36. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
37. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
38. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
39. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
40. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
41. ASTM E2231 – Standard Practice for Specimen Preparation of Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics.
42. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

B. Sheet Metal and Air Conditioning Contractors':

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

C. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE).

D. North American Insulation Manufacturers Association (NAIMA).

E. "National Commercial & Industrial Insulation Standards" – MICA Manual

F. National Fire Protection Association (NFPA)

G. Underwriter's Laboratories Environmental (UL Environment).

1.4 SUBMITTALS

A. Division 01 Section: "Submittal Procedures": Submittal Procedures.

B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.

C. EPD Submittals: As certified by UL Environment.

D. Samples: Submit two samples of representative size illustrating each insulation type.

E. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Comply with VOC limitations under section 099100.

H. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

D. Duct insulation, Coverings, and Linings: UL/ULC Classified per UL 723 or Maximum 25/50 flame spread/smoke developed index, when tested in accordance with ASTM E84, using specimen procedures and mounting procedures of ASTM E 2231.

E. Perform Work in accordance with all applicable codes, standards and local authorities having jurisdiction requirements.

F. Fire-Test-Response Characteristics: Insulation and related materials shall be UL/ULC Classified per UL 723 or have fire-test response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke developed index of 150 or less.

G. Formaldehyde Free: Third party certified with UL Environment Validation.

H. Biosoluble: As determined by research conducted by the International Agency for Research on Cancer (IARC) and supported by revised reports from the National Toxicology Program (NTP) and the California Office of Environmental Health Hazard Assessment. Certified by European Certification Board for Mineral Wool Products (EUCEB).

I. Recycled Content: A minimum of 50 percent recycled glass content certified and UL Validated.

J. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation Products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.

K. Living Building Challenge-Declare Red List Free.

L. Products shall contain no polybrominated diphenyl ethers (PBDE) such as Penta-BDE.

M. Insulation materials shall be tested and rated according to ASTM Test Method C-177 to determine k-factors. ASTM C 335 is for pre-formed pipe insulation. C177 is for flat slab materials ONLY; such as board products, etc.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years experience.

1.7 PRE-INSTALLATION MEETINGS

A. Division 01 Section: “Administrative Requirements”: Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section: “Product Requirements”: Requirements for transporting, handling, storing and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping. Remove and replace any wet or damaged unsatisfactory insulation at the Architect’s direction.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section: “Product Requirements”: Environmental conditions effecting products on site.

B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

C. Maintain temperature during and after installation for minimum period of 24 hours.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

A. Division 01 Section: “Execution and Closeout Requirements”: Product warranties and product bonds.

B. Furnish two-year manufacturer warranty for manmade fiber.

1.12 DEFINITIONS

A. Thermal Conductivity (K value): Units of Btu-inch/hour per square foot per degree F.

B. UL GREENGUARD: Provides independent third party, Indoor Air Quality (IAQ) certification of products for emissions of respirable particles and Volatile Organic Compounds (VOC's), including formaldehyde and other specific product related pollutants. Certification is based upon criteria used by EPA, OSHA, and WHO.

C. EPA: Environmental Protection Agency.

D. WHO: World Health Organization.

E. ASJ+: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with a polypropylene outer film layer leaving no paper exposed.

F. ASJ: Al-service jacket.

G. FSK: Foil, scrim, Kraft paper.

H. FSP: Foil, Scrim, polyethylene.

I. PVDC: Polyvinylidene chloride.

J. SSL+: Self-Sealing Lap with Advanced Closure System.

K. SSL: Self-sealing lap.

L. ASJ Max: All service jacket composed of aluminum foil with tri-directional reinforcing scrim bonded to Kraft paper with a polypropylene outer layer leaving no exposed paper.

M. PSK: Poly Scrim Kraft.

N. PVC: Polyvinyl Chloride.

O. Glass Mineral Wool: Interchangeable with fiber glass, but replacing the term in the attempt to disassociate and differentiate Glass Mineral Wool from the potential health and safety of special purpose or reinforcement products that do not meet the bio solubility criteria of insulation made from glass. Rock Mineral Wool will replace the traditional Mineral Wool label. Both are used in lieu of the Mineral Fiber label.

P. ECOSE® Technology: a revolutionary binder chemistry that enhances the sustainability of products. The "binder" is the bond that holds the Glass Mineral Wool product together and gives the product its shape and brown color. ECOSE Technology is a plant based sustainable chemistry that replaces the phenol/formaldehyde (PF) binder traditionally used in Glass Mineral Wool products. Products using ECOSE Technology are formaldehyde free and have greater reduced global warming potential than compared to products of the past.

Q. UL GREENGUARD Gold Certification: (formerly known as GREENGUARD Children & Schools Certification) offers stricter certification criteria, considers safety factors to account for sensitive individuals (such as children and the elderly), and ensures that a product is acceptable for use in environments such as schools and healthcare facilities. It is referenced; by both The Collaborative for High Performance Schools (CHPS) and the Leadership in Energy Environmental Design (LEED) Building Rating Systems.

R. UL Environment Formaldehyde Free Verification Requirements: For a product to be verified as formaldehyde free, product samples must have a measured emission factor of less than or equal to 5 μg/m²h at 24 elapsed hours or 3 μg/m²h at 336 elapsed hours. An emission factor of 5 μg/m²h corresponds to measured chamber concentration of 2.5 μg/m³ for a typical building ratio of 0.5 m²/m³. This chamber concentration is comparable to, or below typical outdoor air concentrations. This demonstrates that the formaldehyde exposure from products labeled as formaldehyde free will not contribute to airborne formaldehyde concentrations at greater levels than those found in the natural outdoor environment.

S. Imperative 11, Red List – requires that manufacturers disclose the ingredients in their products to insure that they are free of Red List chemicals and materials. The Red List represents the “worst in class” materials, chemicals and elements known to pose serious risks to human health and the greater ecosystem.

T. Underwriters Laboratories Environment (UL Environment): offers independent green claims validation, product assessment and certification. UL GREENGUARD provides third party credibility for sustainable products.

U. UL Environment Claims Validation (ECV): service and label tests a manufacturer’s product and validates that the environmental claims they make in their marketing and packaging materials are factual. This Environmental Claims Validation (ECV) service will allow manufacturers to verify that their products contain a quantifiable amount of recycled content and, as such, help limit raw material extraction and reduce landfill waste. It also will enable products to qualify for LEED® points under Pilot Credit 43: MR – Certified Products.

V. EUCEB: exonerated fiber from a health and safety standpoint by the European Certification Board process.

W. Recycled Content: materials such as bottled glass collected at curbside or other collection sites after consumer use and/or materials used or created from one manufacturing process which are collected as scrap and placed back into another manufacturing process rather than being placed in a landfill or incinerated.

X. Polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE fire retardants: have been linked to adverse health effects after exposure in low concentrations.

Y. UL Classified: UL has tested and evaluated samples of the product with respect to certain properties of the product. UL Classifies products to:

1. Applicable UL requirements.
2. Standards for safety.
3. Standards of other National and International organizations.

Z. EPD: Environmental Product Declaration. A third party verified document that reports environmental data of products based on the Life Cycle Assessment (LCA) and other relevant information, and in accordance with the International Standard ISO 14025 (Type III Environmental Declarations).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles blow introduce lists, the following requirements apply to product selection.

1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INSULATION MATERIALS

A. Refer to Part 3 execution schedule for requirements regarding where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury or mercury compounds.

C. When product to be in contact with austenitic stainless steel is tested according to ASTM C795 (which includes ASTM C692 and ASTM C871), the PH of the leach water from the specific material supplied shall be greater than 7.0 but not greater than 11.7 at 77°F. An acceptable proportion of sodium plus silicate ions to the chloride ions as found by leaching from the insulation is shown in the “plot point” of figure 6 in ASTM C795.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Insulation materials applied to carbon steel shall be Mass Load Corrosion Rate (MLCR) tested per ASTM 1617.

F. Foam insulation materials shall not utilize CFC or HCFC blowing agents n the manufacturing process.

G. Cellular Glass: Inorganic, incombustible, foamed or celluated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in Part 2 “Factory-Applied Jackets” Article.

1. Products:

a. Pittsburgh Corning Corporation; FOAMGLASS® ONE™ Insulation.
b. Specialty Products & Insulation Company (SPI), Lancaster, PA.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Grade 6.
6. Maximum K-Factor: 0.29 at 75 deg. F. mean temperature.
7. Factory fabricates shapes according to ASTM C 450 and ASTM C 585.

H. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products:

a. Aeroflex USA Inc.: Aerocel.
b. Armacell LLC; AP Armaflex.
c. Nomaco; K-Flex Pipe

2. Water Vapor Permeability: 0.02 perm-inch per ASTM E96 Procedure A.
3. Thermal Conductivity: 0.27 at 75 degrees F
4. Warranty: 25 year warranty against breakdown of the membrane due to ultraviolet radiation.
5. Seal Tape: Thermoplastic rubber membrane backed with pressure sensitive adhesive.

I. Glass Mineral Wool Blanket Insulation: Glass mineral wool bonded with a thermosetting resin. Comply with ASTM C 553, Types I, II and III, ASTM C 1136, Type II and ASTM C 1290, Type I or Type III, UL/ULC Classified per UL 723 or FHC 25/50 per ASTM E 84. UL GREENGAURD Gold Certified and UL Environment Validated to be formaldehyde free. Product shall contain no polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE. Factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 “Factory-Applied Jackets” Article.

1. Products:

a. Knauf Insulation; Atmosphere Duct Wrap with Ecose® Technology
b. CertainTeed Corp.; Duct Wrap.
c. Johns Manville; Microlite Duct Wrap or Microlite EQ.
d. Owens Corning; All-Service Duct Wrap Type 150.

2. Maximum K-Factor: 0.24 at 75 deg. F. and material thickness compressed 25%.
3. Minimum Density: 1.5 pounds per cubic foot.

J. Glass Mineral Wool Board Insulation: Glass mineral wool bonded with a thermosetting resin. UL/ULC Classified per UL 723 or FHC 25/50 per ASTM E 84. Comply with ASTM C 612, Type IA or Type IB. Living Building Challenge – Declare Red List Free. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied ASJ+ or ASJ. Factory-applied jacket requirements are specified in Part 2 “Factory-Applied Jackets” Article.

1. Products:

a. Knauf Insulation; Earthwool Insulation Board with Ecose® Technology for temperatures up to 450° F.
b. CertainTeed Corp.; Commercial Board.

c. Johns Manville; 800 Series Spin-Glas, Type 814.
d. Owens Corning; Fiberglas 700 Series for operating temperatures up to 450°F.

2. Maximum K-Factor: 0.23 at 75° F.
3. Minimum density: 2.8 pounds per cubic foot.

2.3 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.4 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Products:

a. Foster Products Corporation, H. B. Fuller Company; 81-84.
b. Pittsburg Corning, PC 99 2k Adhesive.

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II Class I.

1. Products:

a. Armacell LCC; Armaflex 520 Adhesive, Armaflex 520 BLV Low-VOC Adhesive….
b. Foster Products Corporation, H. B. Fuller Company; 85-60.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products:

a. Foster Products Corporation, H. B. Fuller Company; 85-70.
b. Eagle Bridges - Marathon Industries, Inc.; 225.

E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products:

a. Foster Products Corporation, H. B. Fuller Company; 85-70.
b. Eagle Bridges - Marathon Industries, Inc.; 225.

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products:

    a. Dow Chemical Company (The); 739, Dow Silicone.

G. Polyurethane Foam Insulation Board: Manufacturer's recommended synthetic adhesive compatible with polyurethane insulation.

1. Products:

    a. Sarnafil Sarnacol 2170 or Sarnacol 21425.

2.5 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products:

    a. Foster Products Corporation, H. B. Fuller Company; 30-90.
    b. Eagle Bridges - Marathon Industries, Inc.; 590.
    c. Mon-Eco Industries, Inc.; 55-40.
    d. Pittsburg Corning, PITTCOTE 404 Coating.
    e. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products:

    a. Foster Products Corporation, H. B. Fuller Company; 35-00.
    b. Eagle Bridges - Marathon Industries, Inc.; 550.
    c. Mon-Eco Industries, Inc.; 55-50.
    d. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass and Polyisocyanurate Products:

a. Foster Products Corporation, H. B. Fuller Company; 30-45.
b. Eagle Bridges - Marathon Industries, Inc.; 405.
c. Mon-Eco Industries, Inc.; 44-05.
d. Pittsburgh Corning Corporation; PITTSEAL® 444Ns Sealant.
e. Pittsburgh Corning Corporation: PITTSEAL® CW Sealant.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Products:

a. Foster Products Corporation, H. B. Fuller Company; 95-44.
b. Eagle Bridges - Marathon Industries, Inc.; 405.
c. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ+ -SSL+; ASK+ jacket with Self-Sealing Advanced Closure system; complying with ASTM C 1136 Type I, II, III, IV and VII secured with self-sealing longitudinal laps and matching ASK+ butt strips.
2. ASJ+: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with a polypropylene outer film layer.
3. ASJ Max: All service jacket made using aluminum foil and tri-directional reinforcing scrim bonded to Kraft paper with polypropylene outer layer complying with ASTM C 1136, Type I.
4. Redi-Klad Jacket: Factory applied Venture Clad 5-ply weather ad abuse resistant with self-sealing lap. Zero permeability per ASTM E 96-05; puncture resistance 35.4 kg (189.3 N) per ASTM D 1000; tear strength 4.3 lb (19.4 N) per ASTM D 624; thickness 14.5 mils (0.0145”); tensile strength 68 lb/inch width [306 N (32 kg)/25 mm].
5. FSK (FRK) Jacket: Aluminum-foil, fiberglass-reinforced scrim with Kraft-paper backing; complying with ASTM C 1136, Type II.
6. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
7. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a

flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

8. PVDC Jacket for Indoor Applications: 4-mil thick, white PVDC bioxially oritented barrier film with a permeance at 0.02 perms when tested according to ASTM E96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
9. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

    a. Products:
        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
        2) HiCube Coating: HC1000 Vapor Barrier
10. Vinyl Jacket: UL-rated white vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.
11. PSK Jacket, Polypropylene scrim with Kraft.
12. Aluminum-Polyester Self-Adhesive Jacket: 12 mils thick, made with alternating layers of aluminum foil and polyester film coated with cold weather acrylic adhesive. Construction of laminate designed to provide UV resistance, high puncture and tear resistance.

    a. Products:
        1) Armacell LLC; ArmaTuff

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.

1. Products:

    a. Vimasco Corporation; Elastafab 894.

B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.

C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for duct, equipment, and pipe.

1. Products:

    a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
    b. Vimasco Corporation; Elastafab 894.
    c. Pittsburgh Corning Corporation; PC Fabric 79.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with Kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 30 mil thickness; roll stock Ready for shop or field cutting and forming.

1. Products:

   a. Johns Manville; Zeston.
   b. P.I.C. Plastics, Inc.; FG Series.
   c. Proto PVC Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: white
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps and mechanical joints minimum 30 mil thickness.
5. Factory-fabricated tank heads and tank side panels.
6. Provide preformed Fiberglass 1 lb. density 2” thick insulation inserts to comply with ASHRAE 90.1 and ASTM C547 requirements.

D. Metal Jacket:

1. Products:

   a. Childers Products, Division of ITW; Metal Jacketing Systems.
   b. PABCO Metals Corporation; Surefit.
   c. RPR Products, Inc.; Insul-Mate.
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, and Temper H-14.

   a. Sheet and roll stock ready for shop or field sizing.
   b. Thickness:
      1) Up to 24 inch diameter, width, or height: 0.016 inch minimum.
   c. Finish: Smooth finish.
   d. Color: White
   e. Moisture Retarder: 3-mil- thick Polysurlyn (co-extrusion of polyethylene and Dupont Surlyn®, heat laminated to the metal jacketing).
   f. Factory-Fabricated Fitting Covers:
      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and longradius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M

   a. Sheet and roll stock ready for shop or field sizing.
   b. Thickness: 0.016 inch minimum.
   c. Finish: 3/16” corrugations with dull finish.

d. Moisture Retarder: 3-mil- thick Polysurlyn (co-extrusion of polyethylene and Dupont Surlyn®, heat laminated to the metal jacketing).
e. Factory-Fabricated Fitting Covers:
   1) Same material, finish, and thickness as jacket.
   2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
   3) Tee Covers.
   4) Flange and union covers.
   5) End caps.
   6) Beveled collars.
   7) Valve covers.
   8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Self-Adhesive Outdoor Jacket: 60-mil thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross laminated polyethylene film covered with stucco-embossed aluminum-foil facing.

1. Products:

   a. Polygaurd; Alumaguard 60.
   b. MFM Building Products Corp., Flex Clad 400.
   c. Venture Clad Jacketing.
   d. HiCube Coating Jacketing

F. Rubber Membrane: 48-mil thick membrane consisting of a glass fiber carrier coated on both sides with liquid PVC-P Plastisol, and laminated to polyester fleece.

G. Duct Sound Lagging: Reinforced, loaded vinyl noise barrier.

1. Products:

   a. Kinetics; KNM-100 AL
   b. Sound seal; B-10R
   c. Unger Technologies, Inc.; Model DL-10-LAG
2. Sound Transmission Class (STC) rating: 26.
3. Density: 1 pound per square foot.

H. Refrigerant Piping Insulation Covering for Outdoor Installations.

1. An insulation protective cover shall be provided and installed to be flexible, U/V and weather resistant. The PVC plastic pipe insulation cover as manufactured by AIREX E FLEXGUARD or comparable acceptable product, and shall feature an integrated, outdoor-rated durability, industrial-grade, full-enclosure fastening system that is double secured by molecular bonding, allowing custom, cut-to-length installations. The cut-to-length installations shall comprise of a non-unraveling PVC cover material that does not compromise long-term-effectiveness or require specialized tools and cutting equipment. The engineered fastening system shall allow the cover to be removable and reusable for maintenance without the use of adhesives as an attachment in any shape or form, including either in the protector’s construction, installation, or attachment to pipe insulation, as this will negatively affect insulation permeance performance and promote insulation material degradation which causes added energy usage by equipment. WRAPPING TAPE OR ADHESIVE TAPE SHALL NOT BE PERMITTED AS PER

ENERGY CODES. Insulation Protector shall be tested and meet the following testing: ASTM E 96 (Vapor Transmission of Materials), ASTM G 153 (Carbon Arc Light Exposure – Accelerated Weathering), ASTM D 412 (Tensile Strength after UV Exposure and Water Immersion), ASTM 570 (Water Absorption of Plastics), ASTM E 84/UL 723 (Surface Burning Characteristics of Building Materials, ASTM G 21 (Fungal Growth). UV/Protector Pipe Insulation Material shall meet Class II vapor retarder per ASTM E 96 (vapor/moisture permeability test) “1 perm or less”. THE USE OF U/V PAINT OR NON-PERMEABLE MATERIALS OR ADHESIVES ARE NOT PERMITTED FOR THIS APPLICATION.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 11F36 and UL listed.

1. Products:

   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
   b. Compac Corp.; 104 and 105.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   e. HiCube Coating: HC108
2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.

1. Products:

   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   b. Compac Corp.; 110 and 111.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
   d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
   e. HiCube Coating: HC106
2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products:

   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.

b. Compac Corp.; 130.
c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
d. Venture Tape; 1506 CW NS.
e. HiCube Coating: HC404

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.

1. Products:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
b. Compac Corp.; 120.
c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
d. Venture Tape; 3520 CW.
e. HiCube Coating: HC100

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

E. Elastomeric Foam Tape: Black vapor-retarder foam tape with acrylic adhesive containing, EPA approved anti-microbial additive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Armacell LLC; AP/Armaflex Insulation Tape
b. Approved Equal

2.11 SECUREMENTS

A. Bands:

1. Products:

a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
5. Tape:

a. 3M: Scotch Brand #880

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.

    a. Products:
        1) AGM Industries, Inc.; CWP-1.
        2) GEMCO; CD.
        3) Midwest Fasteners, Inc.; CD.
        4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

    a. Products:
        1) AGM Industries, Inc.; CWP-1.
        2) GEMCO; Cupped Head Weld Pin.
        3) Midwest Fasteners, Inc.; Cupped Head.
        4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Products:
        1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
        2) GEMCO; Perforated Base.
        3) Midwest Fasteners, Inc.; Spindle.
    b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106- inch-diameter shank, length to suit depth of insulation indicated.
    d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Products:
        1) GEMCO; Nylon Hangers.
        2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
    b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
    c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
    d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inchthick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products:
   1) AGM Industries, Inc.; RC-150.
   2) GEMCO; R-150.
   3) Midwest Fasteners, Inc.; WA-150.
   4) Nelson Stud Welding; Speed Clips.
b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

6. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

   a. Manufacturers:
      1) GEMCO.
      2) Midwest Fasteners, Inc.

7. Insulation Pipe Hanger Supports: Support piping system using high-density inserts with sufficient compressive strength, embedded within flexible elastomeric foam, with thickness equal to or greater than the pipe insulation.

   a. Products: subject to compliance with requirements, available products that may be incorporated into the work include, but not limited to, the following:
      1) Armacell LLC; Armafix IPH
      2) Approved Equal

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

   1. Manufacturers:

      a. ACS Industries, Inc.
      b. C & F Wire.
      c. Childers Products.
      d. PABCO Metals Corporation.
      e. RPR Products, Inc.

2.12 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

2.13 DUCT SOUND LINING (Refer to Division 23 Section: "HVAC Air Distribution.")

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section: "Administrative Requirements:" Coordination and project conditions.

B. Verify piping, equipment and ductwork has been tested before applying insulation materials.

C. Verify surfaces are clean and dry, with foreign material removed.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 COMMON INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Install insulation continuously through hangers and around anchor attachments.

K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at anchors and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

M. Install insulation with self-sealing factory-applied jackets as follows:

1. Locate all longitudinal pipe insulation jacketing laps in least visible location.
2. Draw jacket tight and smooth.
3. For proper sealing, seal lap joints with reasonable pressure being applied with a plastic squeegee or sealing tool.
4. Vapor seal all circumferential joints with factory furnished matching pressure sensitive butt strips installed with reasonable pressure being applied with a plastic squeegee or sealing tool.

N. Install insulation with non-self-sealing factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive selfsealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

O. Cut and install insulation in a manner to avoid compressing insulation more than 25 percent of its original nominal thickness.

P. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

Q. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

R. Replace insulation on existing piping, and equipment where indicated on the drawings. Match insulation type and thickness indicated by the insulation schedule at the end of this section.

S. Replace insulation on new and existing piping, and equipment where insulation is damaged during construction or removed for testing and balancing work.

T. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.
7. Unions.
8. Flanges.
9. Expansion joints.

U. Duct and plenum liner application: Refer to Division 23 Section: “HVAC Air Distribution.”

V. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.

W. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

X. Exterior Applications: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminium with seams located at 3 or 9 o’clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal equipment.

Y. Insulate chilled water valves and strainers with closed cell insulation.

3.4 BUILDING PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Pipe: Install insulation continuously through floor penetrations.

3.5 DUCT AND PLENUM INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with insulation pins.

1. Install either capacitor discharge weld pins and speed washers or cupped head, capacitor discharge weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches oc.
b. On duct sides with dimensions larger than 18 inches, place pins 16 inches oc. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not over compress insulation during installation; maximum 25 percent compression.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
g. Pressure sensitive foil tapes shall be a minimum 3” wide and shall be applied with moving pressure using a squeegee or other appropriate sealing tool.

2. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with ½ inch outward clinching staples, 1 inch oc. Install vapor barrier consisting of vapor barrier acrylic based tape; matching the facing, or factory or field-applied jacket, adhesive, vapor barrier mastic, and sealant at joints, seams, and protrusions. Follow NAIMA's "Guide to insulating Chilled Water Piping Systems with Mineral Fiber Pipe Insulation" for additional details when installing Pipe and Tank Insulation.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg. F at 18 foot intervals. Vapor stops shall consist of vapor barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
    c. Where vapor retarder performance is required, all penetrations and damage to the facing shall be repaired using pressure sensitive foil tape or mastic prior to system startup.
    d. Pressure sensitive foil tapes shall be a minimum 3” wide and shall be applied with moving pressure using a squeegee or other appropriate sealing tool.
3. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches oc.
4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat oval duct elbows with individually mitered gores cut to fit the elbow.
5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6 inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches oc.

B. Board Insulation Installation on Ducts and Plenums: Secure with insulation pins.

1. Install either capacitor discharge weld pins and speed washers or cupped head, capacitor discharge weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. Apply insulation with joints butted as close as possible to the duct surface.
    b. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches oc.
    c. On duct sides with dimensions larger than 18 inches, space pins 16 inches oc. Each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    d. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    e. Do not over compress insulation during installation.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
    g. All joints shall be sealed using minimum 3 inch wide pressure sensitive, acrylic based tape; matching the facing. Tape shall be firmly rubbed; using a plastic squeegee or sealing tool to assure complete bond.
2. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Install vapor barrier consisting of vapor barrier acrylic based

tape; matching the facing, or factory or field applied jacket, adhesive, vapor barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18 foot intervals. Vapor stops shall consist of vapor barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
c. All joints shall be sealed using minimum 3 inch wide pressure sensitive, acrylic based vapor barrier tape; matching the facing. Tape shall be firmly rubbed; using a plastic squeegee or sealing tool to assure complete bond.

3. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat oval duct elbows with individually mitered gores cut to fit the elbow.
4. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6 inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches oc.

(The use of adhesive to secure insulation to ductwork is not advised. It MAY affect the FHC of the insulation. It also adversely affects the installation; particularly of Duct Wrap because the insulation is more difficult to position on the ductwork; especially in tight spaces.)

C. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer’s recommended adhesive.
2. Seal longitudinal seams and end joints.

3.6 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Fittings shall be insulated to same thickness as the adjoining insulation. Apply fittings per fitting manufacturer’s instructions. When required by specification, a hard insert of sufficient length shall be utilized to avoid compression of the insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve

stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word UNION.” Match size and color of pipe labels.

C. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

D. Insulation Installation for Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with Glass Mineral Wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

E. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed formaldehyde free Glass Mineral Wool fittings; minimum 50 percent recycled glass content, of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

3.7 CELLULAR-GLASS INSULATION INSTALLATION

A. A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellularglass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer’s recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer’s written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with tape or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.8 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

E. Insulation Installation on Ductwork:

1. Cut to bottom piece first, making it the same width as the duct. Then cut the two side pieces, so that they extend down over the edges of the bottom insulation; keep top edges flush with the top of the duct. The top insulation should be sized so that it extends over the side insulations.
2. Cut elastomeric insulation pieces cleanly using a sharp knife and a straightedge.
3. Apply manufacturers recommended adhesive. First brush- or roller-coat adhesive on the metal duct surface. Then coat the back side of the insulation sheet, leaving a 1/2"-wide uncoated border at butt-edge seams. Allow the adhesive to dry to the touch but still tacky under slight pressure before joining surfaces.
4. Position the sheet so that it overlaps the edges of previously installed sheet or sheets by 1/8". Hold the sheet in this position, and spot-adhere it in the center. Compress the butt edges into place for a tight joint with adjoining sheets. Then bond the remainder of the sheet by pressing it firmly into place. Use a small hand roller to apply pressure.
5. Spread the joint, and with a small brush, apply adhesive to both butt edges. Do not flood joint with adhesive. Align carefully for good appearance, and apply pressure to joint.
6. Insulate standing seams with strips of elastomeric insulation sheet.
7. Refer to Part 3 Section "Field-Applied Jacket Installation" for jacket installation requirements.

3.9 ROCK MINERAL WOOL INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials, unless ASJ SSL jacketing is being used.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer’s recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with insulation pins.

1. Apply adhesives according to manufacturer’s recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2- inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. (10 deg C) at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

F. Board Insulation Installation on Ducts and Plenums: Secure with insulation pins.

1. Apply adhesives according to manufacturer’s recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.

e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2- inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.10 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

   1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
   3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer’s recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer’s recommended adhesive.

   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

2. For exterior refrigerant piping utilize PVC plastic pipe insulation cover, cut-to-length full enclosure fastening system. NO ADHESIVE TAPE OR WRAPPING TAPE SHALL BE PERMITTED PER ENERGY CODE.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

1. Where rubber membrane jackets are indicated, install the membrane using the manufacturer's recommended adhesive. Before use thoroughly stir the adhesive. Replace the container lid when work is interrupted. If required thin the adhesive as recommended by the manufacturer.
2. Using a sheepskin or similar roller apply a primer coat of adhesive to the roof surface, priming only the area of roof where the membrane will be laid the same day. Allow adhesive to dry.
3. Unroll the membrane and fold back approximately half its length.
4. Apply adhesive with a sheepskin or similar roller to the underside of the membrane ensuring the weld area is kept free of adhesive and allow to touch dry.
5. Carefully roll out the membrane over the previously primed surface and roll with water filled roller.
6. Fold back other half of the roll of membrane and repeat the procedure.
7. Unroll the next roll of membrane, ensuring the end laps are staggered and the side overlaps the previously installed sheet by 2 inches.
8. Repeat the adhering process.
9. Fully hot air weld the 2-inch side lap, allow to cool completely.
10. Mechanically check the integrity of the cooled weld by running a 3/16-inch wide screwdriver (with rounded edges) along the seam applying pressure into the seam.
11. Install Peel Stop and PVC Welding Cord at all perimeters, penetrations and changes of roof direction.

3.11 FINISHES

A. Finish Duct, Equipment, and Pipe Insulation with ASJ, Glass Cloth, or Other Paintable Jacket Material. Clad-Type Jacketing such as Venture RediKlad or Venture Clad may be utilized.

B. Flexible Elastomeric Thermal Insulation: after adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed work.

D. Do not field paint aluminum or stainless-steel jackets.

3.12 INSULATION APPLICATION SCHEDULE

A. Acceptable insulation materials, thickness and vapor retarder requirements are identified for each application and size range. If more than one material is listed for an application and size range, selection from the materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Fire-suppression piping.
2. Drainage piping located in crawl spaces.
3. Below-grade piping.
4. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
5. Exhaust ductwork
6. Factory-insulated flexible ducts.
7. Factory-insulated plenums and casings.
8. Flexible connectors.
9. Vibration-control devices.
10. Factory-insulated access panels and doors.

C. All supply and outside air ductwork with internal sound lining shall be externally insulated.

D. Where metal ducts are specified to have internal duct liner, the thickness of the external insulation may be reduced by one inch, except minimum duct external insulation thickness shall be 1 inch.

3.13 HVAC PIPING INSULATION APPLICATION SCHEDULE:

1. Unconditioned spaced include locations where summer temperature and humidity conditions are similar to outdoor conditions (such as mechanical rooms ventilated with unconditioned outdoor air, etc.). Pipes in these spaces to be insulated similar to outdoor requirements.
2. Where rigid pipe insulation (cellular glass, etc.) is scheduled, provide mineral fiber through and 6 inches beyond pipe sleeves, to allow for pipe expansion.

Miscellaneous (all supply and return)	Type of Insulation Material	Vapor Retarder Required	Pipe Size	Insulation Thickness Required
Air conditioning condensate drain, equipment drain,	Flexible Elastomeric	No	<1”	0.5”
			1” to <8”	1”
			≥8”	1.5”
Refrigerant pipe	Flexible Elastomeric	No	All	1”
Fuel oil (Outdoor)	Glass Mineral Wool	Yes	All	2”

3.14 HVAC DUCTWORK INSULATION APPLICATION SCHEDULE

1. Unconditioned spaced include locations where summer temperature and humidity conditions are similar to outdoor conditions (such as mechanical rooms ventilated with unconditioned outdoor air, etc.)
2. Top of ductwork located outdoors shall be provided with polyurethane board insulation of equal thickness to sides and bottoms. Taper insulation to shed water, minimum ¼” per foot slope, with insulation thickness at low edges equal to scheduled insulation thickness.
3. All diffuser cones, air valves, damper boxes, HVAC equipment, coils, coil headers, casings, plenums, air measuring devices, etc. shall be insulated.

Supply air ductwork, plenums, and accessories	Type of Insulation Material	Vapor Retarder Required	Insulation Thickness Required
Concealed (Indoor)	Glass Mineral Wool Blanket	Yes	1.5”
Exposed (Indoor)	Glass Mineral Wool Board	Yes	1.5”
Attic and unconditioned spaces (Indoor)	Glass Mineral Wool Board	Yes	2”
Heating only (Indoor)	None	No	

Return and transfer air ductwork, plenums, and accessories	Type of Insulation Material	Vapor Retarder Required	Insulation Thickness Required
In locations other than attics and unconditioned spaces (Indoor)	None	No	
Attic and unconditioned spaces (Indoor)	Glass Mineral Wool Board	Yes	2”
Between relief air damper and outdoors, louver, louver penthouse, etc.	Glass Mineral Wool Board **<<Flexible Elastomeric>>**	Yes **<<No>>**	2”

Outdoor air ductwork, plenums, and accessories	Type of Insulation Material	Vapor Retarder Required	Insulation Thickness Required
Concealed (Indoor)	Glass Mineral Wool Blanket **<<Flexible Elastomeric>>**	Yes **<<No>>**	1.5”
Exposed (Indoor)	Glass Mineral Wool Board **<<Flexible Elastomeric>>**	Yes **<<No>>**	2”

Attic and unconditioned spaces (Indoor)	Glass Mineral Wool Board **<<Flexible Elastomeric>>**	Yes **<<No>>**	2”

3.15 HVAC EQUIPMENT INSULATION APPLICATION SCHEDULE

HVAC SERVICE	TYPES OF INSULATION MATERIAL	INSULATION THICKNESS REQUIRED	VAPOR RETARDER REQUIRED
Outdoor, Aboveground, Fuel-Oil Storage Tank	Glass Mineral Wool Board; or Glass Mineral Wool Pipe and Tank	2”	No

3.16 FIELD APPLIED JACKET APPLICATION SCHEDULE

SERVICE	FIELD APPLIED JACKET TYPE
Indoor, exposed insulated piping within 12 feet of floor, for service temperatures 200 degrees F and below	PVC
Indoor, exposed insulated piping within 12 feet of floor, for service temperatures 200 degrees F and above	Aluminum
Indoor, exposed insulated piping greater than 12 feet above floor, generally	None
Indoor concealed piping	None
Outdoor exposed piping	Aluminum
Indoor, All Locations, Fittings and valves in piping systems at service temperatures 200 degrees F and below	Factory Fabricated PVC covers
Indoor, All Locations, Fittings and valves in piping systems at service temperatures 200 degrees F and above	Aluminum
Indoor, exposed insulated ductwork within 12 feet of floor	Woven Glass Fiber Fabric
Indoor, exposed insulated ductwork greater than 12 feet of floor	None
Indoor, concealed insulated ductwork	None
Indoor, exposed insulated ductwork	Aluminum or Self-Adhesive Outdoor Jacket
Equipment, generally (Refer to Notes 1 & 2)	Woven Glass Fiber Fabric

Jacket Application Schedule Notes:

1. Refer to Part 3 specification section titled “Mechanical Equipment, Tank, and Vessel Insulation Installation” for requirements for revocable, re-usable metal boxes lined with insulation at pumps.
2. Including factory insulated equipment without factory applied jacket.
3. If ductwork or piping indicated to have sound lagging also requires an additional field jacket, install sound lagging between insulation and additional field jacket.

END OF SECTION

SECTION 23 08 00
COMMISSIONING OF HVAC

PART 1 GENERAL

1.01 DESCRIPTION

A. The purpose of this Section is to specify Division 23 responsibilities in the commissioning process which are being directed by the Commissioning Authority (CxA). Other Mechanical systems testing may be required under the direction of the Construction Manager (CM).

B. Commissioning requires the participation of Division 23 Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents.

C. The contractor shall execute all commissioning responsibilities assigned to them described in Section 01 75 00 "General Commissioning Requirements", the Contract Documents, and in the Commissioning Plan issued by the CxA.

1.02 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration

D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

E. Refer to Section 017500 for additional definitions related to the commissioning process.

1.03 INFORMATIONAL SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

C. Pre-functional checklists for all commissioned equipment.

D. Manufacturer startup forms for all commissioned equipment.

E. All third party reports and test information require by the Division 23 Sections.

1.04 RESPONSIBILITIES

A. Mechanical Contractor: The commissioning responsibilities applicable to the Division 23 contractor are as follows (all references apply to commissioned equipment):

1. Construction and Acceptance Phases
   a. Attend a commissioning scoping meeting and other necessary meetings scheduled by the CxA to facilitate the commissioning process.
   b. Contractors shall provide product data and shop drawing submittals to the CxA for commissioned equipment during normal submittal procedures.
   c. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of startup and functional testing procedures
      1) Typically this will include detailed manufacturer installation and startup, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, and full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CxA
      2) The CxA may request further documentation necessary for the commissioning process
      3) This data request may be made prior to normal submittals
   d. Provide a copy of the O&M manual submittals of commissioned equipment, through normal channels, for the CxA for review

e. Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, drawings or equipment documentation is not sufficient for writing detailed testing procedures.
f. Provide assistance to the CxA in preparation of the specific functional performance test procedures. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
g. Develop a full startup and initial checkout plan using manufacturer's startup procedures and the pre-functional checklists from the CxA. Submit manufacturer's detailed startup procedures and the full startup plan and procedures and other requested equipment documentation to CxA for review.
h. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.
i. Address current A/E punch list items before functional testing.
j. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
k. Perform functional performance testing under the direction of the CxA for specified equipment in 017500, and Section 3.9. Assist the CxA in interpreting the monitoring data, as necessary.
l. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA, GC, CM and A/E and retest the equipment.
m. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
n. During construction, maintain as-built red-line drawings for all drawings and final CAD as-built for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing). Prepare red-line as-built drawings for all drawings and final as-builts for contractor-generated coordination drawings.
o. Provide training of the Owner's operating personnel as specified.
p. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
q. Attend testing, adjusting, and balancing review and coordination meeting.
r. Participate in orientation and inspection for Division 23 systems, assemblies, equipment, and component maintenance as directed by the CxA.
s. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

2. Warranty Period
   a. Execute deferred functional performance testing, witnessed by the CxA, according to the specifications
   b. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

B. TAB Contractor:
1. Provide all TAB reports required by Section 230593 to the CxA for concurrent review with the EOR and Owner.
2. Prerequisite of TAB Verification and Testing: Completion of "Examination" Article requirements and correction of deficiencies, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
3. Completion of "Preparation" Article requirements for preparation of a TAB plan that includes strategies and step-by-step procedures, and system-readiness checks and reports, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
4. Scope: HVAC&R air systems and hydronic piping systems.
5. Conditions of the Test:

a. Commissioning Test Demonstration Sampling Rate: As specified in "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
b. Systems operating in full heating mode.
c. Systems operating in full cooling mode.
d. For measurements at air-handling units with economizer controls; systems operating in economizer mode with 100 percent outside air.

6. Acceptance Criteria:
   a. Under all conditions, rechecked measurements comply with "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
   b. Additionally, no rechecked measurement shall differ from measurements documented in the final report by more than two times the tolerances allowed.
   c. Under all conditions, where the Contract Documents indicate a differential in airflow between supply and exhaust and/or return in a space, the differential relationship shall be maintained

1.05 COMMISSIONING DOCUMENTATION

A. Contractor to provide the following information to the CxA for inclusion in the commissioning plan:
   1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
   2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
   3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for Division 23 systems, assemblies, equipment, and components to be verified and tested.
   4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
   5. Certificate of readiness certifying that Division 23 systems, subsystems, equipment, and associated controls are ready for testing.
   6. Test and inspection reports and certificates.
   7. Corrective action documents.
   8. Verification of testing, adjusting, and balancing reports.

1.06 RELATED WORK

A. Refer to Section 017500 for a listing of all sections where commissioning requirements are found.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. Division 23 shall provide all test equipment necessary to fulfill the testing requirements of this Division.

B. Refer to Section 017500 for additional Division 23 requirements.

PART 3 EXECUTION

3.01 SUBMITTALS

A. Division 23 shall provide submittal documentation relative to commissioning to the CxA as requested by the CxA. Refer to Section 017500 for additional Division 23 requirements

3.02 STARTUP AND PRE-FUNCTIONAL PROCEDURES

A. The Mechanical contractors shall follow the startup and initial checkout procedures listed in the Responsibilities list in this section and in 017500. Division 23 has startup responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility to the commissioning agent or Owner.

B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems, or sub-systems at the discretion of the CxA and CM. Beginning system testing before full completion does not relieve the Contractor of responsibility for fully completing the system, including all pre-functional checklists as soon as possible.

C. A representative pre-functional checklist (PFC) can be provided to illustrate the format and rigor of testing required for this section. Similar checklists will be developed by the CxA for all other equipment to be commissioned as listed in Section 017500 and XX 08 00 sections.

D. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

E. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

F. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

G. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

H. Inspect and verify the position of each device and interlock identified on checklists.

I. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

J. Testing Instrumentation: Provide and install measuring instruments and logging devices to record test data as directed by the CxA.

K. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

L. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work

M. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
   1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
   2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
   3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
   4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

N. The CxA along with the Division 23 Contractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

O. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
   1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section

of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.

2. Description of equipment for flushing operations.
3. Minimum flushing water velocity.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

3.03 FUNCTIONAL PERFORMANCE TESTS

A. Refer to Section 3.9 for a list of systems to be commissioned.

B. A representative functional performance test (FPT) can be provided to illustrate the format and rigor of testing required for this section. Similar checklists will be developed by the CxA for all other equipment to be commissioned as listed in Section 017500.

C. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

D. Scope of HVAC&R testing shall include entire HVAC&R installation. Testing shall include measuring capacities and effectiveness of operational and control functions.

E. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

F. Tests will be performed using design conditions whenever possible.

G. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

H. The CxA may direct that set points be altered when simulating conditions is not practical.

I. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

J. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

K. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

L. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of gas systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

M. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

N. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

O. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

P. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 230900 "Instrumentation and Control".

3.04 TESTING DOCUMENTATION, NON-CONFORMANCE, AND APPROVALS

A. Refer to Section 017500 for specific details on non-conformance issues relating to pre-functional checklists and tests.

B. Refer to Section 017500 for issues relating to functional performance tests.

3.05 OPERATION AND MAINTENANCE MANUALS (O&M) MANUALS

A. Division 23 shall compile and prepare documentation for all equipment and systems covered in Division 23 and deliver to the CM for inclusion in the O&M manuals, according to Sections

B. The CxA shall receive a copy of the O&M manuals for concurrent review.

3.06 TRAINING OF OWNER PERSONNEL

A. The CM shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed. Refer to Section 017500 for additional details.

B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment. Refer to Section 017500 for additional details.

C. Provide the CxA with a training plan eight (8) weeks before the planned training according to the outline described in Section 017500.

D. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned mechanical equipment or system.

E. Training shall start with classroom sessions, if necessary, followed by hands on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.

F. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

G. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the startup technician for the piece of equipment, the installing contractor or manufacturer’s representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than one party may be required to execute the training.

H. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

I. Training shall include:
   1. Use the printed installation, operation and maintenance instruction material included in the O&M manuals
   2. Include a review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include startup, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
   3. Discuss relevant health and safety issues and concerns.
   4. Discuss warranties and guarantees.
   5. Cover common troubleshooting problems and solutions.
   6. Explain information included in the O&M manuals and the location of all plans and manuals in the facility.
   7. Discuss any peculiarities of equipment installation or operation.

8. The format and training agenda in Guidelines for Commissioning HVAC Systems, ASHRAE, Guideline 0-2005 is recommended.
9. Classroom sessions shall include the use of overhead projections, slides, video and audio taped material as appropriate

J. Hands-on training shall include startup and operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.

K. The mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.

L. Training shall occur after functional testing is complete, unless approved otherwise by the CM, Owner, and CxA.

3.07 DEFERRED TESTING

A. Refer to Section 017500 for requirements of deferred testing.

3.08 WRITTEN WORK PRODUCTS

A. Written work products of Contractors will consist of the startup and initial checkout plan described in Section 017500 and the filled out startup, initial checkout and pre-functional checklists.

3.09 SYSTEMS TO BE COMMISSIONED

A. The following is a list of systems to be commissioned. This list may be missing an item and the assumption should be that all equipment is included in commissioning. It should be noted that the CxA intends to test all contracted terminal equipment at a sampling of 20% and all primary equipment.

SECTION	SYSTEM DESCRIPTION	SAMPLING
	SPLIT SYSTEM HVAC UNITS	100%
	PACKAGED ROOFTOP UNIT	100%
	DEDICATED OUTSIDE AIR UNIT	100%
	VRF SYSTEMS	100%
	EXHAUST FANS	100%
	ELECTRIC UNIT HEATERS	100%

END OF SECTION

SECTION 23 09 00
INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, and the other sections of Division 23.

1.2 SUMMARY

A. Section includes:

1. Control system software.
2. Control system hardware.
3. Wiring
4. Sensors.
5. Thermostats.
6. Control dampers.
7. Control components, etc.
8. Uninterruptible Power Supplies

B. Related Sections: The following Sections contain requirements that relate to this section:

1. Division 23 Section: “Common Work Results for HVAC”: Submittal execution requirements for work under this section.
2. Division 23 Section: “Common Motor Requirements For HVAC Equipment”.
3. Division 23 Section: “Pipes and Tubes for HVAC Piping and Equipment”: Product requirements for thermometer sockets.
4. Division 23 Section: “HVAC Air Distribution”: Product requirements for duct mounted thermometers.
5. Division 26 Section: “Common Work Results for Electrical”: Execution requirements for electric connections specified by this section.
6. Division 26 Section: “Common Work Results for Electrical.”
7. Division 26 Section: “Low Voltage Electrical Power Conductors & Cables.”
8. Division 26 Section: “Raceways & Boxes for Electrical Systems”: Wiring and raceway requirements.
9. Division 26 Section: “Low Voltage Controllers”: for interface with starters under electrical division.
10. Division 28 Section: “Fire Detection and Alarm: Wiring for duct detectors.

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”)

A. All work shall conform to the following Codes and Standards, as applicable.

B. Americans Disability Act (ADA).

C. Air Movement and Control Association International, Inc.:

1. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating.

D. American National Standards Institute (ANSI).

1. ANSI/EIA 909.1-A (LonWorks)
2. ANSI/ASHRAE Standard 193 (BACnet)
3. ANSI MC85.1 - Terminology for Automatic Control.

E. American Society of Heating, Refrigerating and Air-Conditioning Engineers.

1. ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.

F. American Society of Mechanical Engineers:

1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

G. ASTM International:

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
2. ASTM A536 - Standard Specification for Ductile Iron Castings.
3. ASTM B32 - Standard Specification for Solder Metal.
4. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
5. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

H. American Standard Code for Information Interchange (ASCII).

I. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding

J. Electronics Industries Association (EIA).

K. Factory Mutual (FM).

L. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.

M. Institute of Electrical and Electronic Engineers (IEEE).

N. National Electric Code (NEC).

O. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA DC 3 - Residential Controls - Electrical Wall-Mounted Room Thermostats.

P. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.
2. NFPA 72 - National Fire Alarm and Signaling Code.
3. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.

Q. Occupational Safety and Health Administration (OSHA).

R. Underwriters Laboratories, Inc.:

1. UL 268 Smoke Detectors for Fire Alarm Systems.
2. UL 864 Control Units and Accessories for Fire Alarm Systems.
3. UL 916 Energy Management Equipment.

S. In the case of conflicts or discrepancies, the more stringent regulation shall apply.

T. All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

1.4 DEFINITIONS

A. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.

B. Binary: A two-state system where an “ON” condition is represented by one discrete signal level and an “OFF” condition is represented by a second discrete signal level.

C. Building Automation System (BAS): The total integrated system of fully operational and functional elements, including equipment, software, programming, and associated materials, to be provided by this Section and to be interfaced to the associated work of other related trades.

D. BAS Contractor: The single Contractor to provide the work of this Section. This Contractor shall be the primary manufacturer, installer, BAS commissioning agent, and ongoing service provider for the BAS work.

E. Control Sequence: A BAS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.

F. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BAS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.

G. BAS Network: The total digital on-line real-time interconnected configuration of BAS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.

H. Node: A digitally programmable entity existing on the BAS network.

I. BAS Integration: The complete functional and operational interconnection and interfacing of all BAS work elements and nodes in compliance with all applicable codes, standards and ordinances so as to provide a single coherent BAS as required by this Division.

J. PC: IBM-compatible Personal Computer from a recognized major manufacturer.

K. Wiring: The term “Wiring” and its derivatives when used in this Division shall mean provide the BAS wiring and terminations, including all low voltage and power (line voltage) wiring.

L. Protocol: The term “protocol” and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BAS network nodes.

M. Software: The term “software” and its derivatives when used in this Division shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BAS industry for real-time, on-line, integrated BAS configurations.

N. The use of words in the singular shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.

O. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.

1.5 ACRONYMS

A. The following abbreviations and acronyms may be used in describing the work of this Division:

1.	ADC	-	Analog to Digital Converter
2.	AI	-	Analog Input
3.	AN	-	Application Node
4.	ANSI	-	American National Standards Institute
5.	AO	-	Analog Output
6.	ASCII	-	American Standard Code for Information Interchange
7.	ASHRAE		American Society of Heating, Refrigeration and Air Conditioning Engineers
8.	AWG	-	American Wire Gauge
9.	CPU	-	Central Processing Unit
10.	CRT	-	Cathode Ray Tube
11.	DAC	-	Digital to Analog Converter
12.	DDC	-	Direct Digital Control
13.	DI	-	Digital Input
14.	DO	-	Digital Output
15.	EEPROM		Electronically Erasable Programmable Read Only Memory
16.	EMI	-	Electromagnetic Interference
17.	FAS	-	Fire Alarm Detection and Annunciation System
18.	GUI	-	Graphical User Interface
19.	HOA	-	Hand-Off-Auto
20.	ID	-	Identification
21.	IEEE	-	Institute of Electrical and Electronics Engineers
22.	I/O	-	Input/Output
23.	LAN	-	Local Area Network

24. LCD - Liquid Crystal Display
25. LED - Light Emitting Diode
26. MCC - Motor Control Center
27. NC - Normally Closed
28. NIC - Not In Contract
29. NO - Normally Open
30. OWS - Operator Workstation
31. OAT - Outdoor Air Temperature
32. PC - Personal Computer
33. RAM - Random Access Memory
34. RF - Radio Frequency
35. RFI - Radio Frequency Interference
36. RH - Relative Humidity
37. ROM - Read Only Memory
38. RTD - Resistance Temperature Device
39. SPDT - Single Pole Double Throw
40. SPST - Single Pole Single Throw
41. XVGA - Extended Video Graphics Adapter
42. TBA - To Be Advised
43. TCP/IP - Transmission Control Protocol/Internet Protocol
44. TTD - Thermistor Temperature Device
45. UPS - Uninterruptible Power Supply
46. VAC - Volts, Alternating Current
47. VAV - Variable Air Volume
48. VDC - Volts, Direct Current
49. WAN - Wide Area Network

1.6 BAS DESCRIPTION

A. The Building Management System (BAS) shall be a complete system designed for use with the enterprise IT systems. This functionality shall extend into the equipment rooms. Devices residing on the automation network located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BAS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.

B. Automatic temperature controls field monitoring and control system using field programmable microprocessor based units.

C. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.

D. Provide computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.

E. All points of user interface shall be on standard PCs that do not require the purchase of any special software from the BAS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.

F. Where necessary and as dictated elsewhere in these Specifications, Servers shall be used for the purpose of providing a location for extensive archiving of system configuration data, and historical data such as trend data and operator transactions. All data stored will be through the use of a standard data base platform: Microsoft Data Engine (MSDE) or Microsoft SQL Server as dictated elsewhere in this specification.

G. The work of the single BAS Contractor shall be as defined individually and collectively in all Sections of this Division specification together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.

H. The BAS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BAS.

I. Provide a complete, neat and workmanlike installation. Use only manufacturer certified employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.

J. Manage and coordinate the BAS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

K. The BAS as provided shall incorporate, at minimum, the following integrated features, functions and services:

1. Operator information, alarm management and control functions.
2. Enterprise-level information and control access.
3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
4. Diagnostic monitoring and reporting of BAS functions.
5. Offsite monitoring and management access.
6. Energy management
7. Standard applications for terminal HVAC systems.
8. Uninterruptible Power Supplies.

L. Provide installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

1.7 SUBMITTALS

A. Division 01 Section: “Submittal Procedures”: Submittal Procedures.

B. Shop Drawings, Product Data, and Samples:

1. The BAS contractor shall submit a list of all shop drawings with submittal dates within 30 days of contract award.

2. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.
3. Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total BAS work.
4. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing and permitting shall be at the expense of the BAS Contractor. Provide a copy of all related correspondence and permits to the Owner.
5. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
6. At a minimum, submit the following:

    a. BAS network architecture diagrams including all nodes and interconnections.
    b. Systems schematics, sequences and flow diagrams.
    c. Floor plan drawings showing detailed locations of all field installed control components such as sensors, dampers, actuators, control panels, etc.
        1) AutoCAD mechanical drawings will be provided to the BAS contractor, upon receipt of Bowman's Electronic Document Release Form, per Division 23 Section: "Common Work Results for HVAC."
        2) Indicate all provisions required for adequate maintenance access.
    d. Points schedule for each point in the BAS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
    e. Samples of Graphic Display screen types and associated menus.
    f. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
    g. Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
    h. Details of all BAS interfaces and connections to the work of other trades.
    i. Product data sheets or marked catalog pages including part number, photo and description for all products including software.
    j. Detailed training agendas.
    k. Start-up and controls commissioning checklist.

C. Samples: Submit two of each type of room thermostat / temperature sensor and humidistat / humidity sensor, including covers and guards.

D. Manufacturer's Installation Instructions: Submit.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

F. LEED Submittals: Comply with Section 018113.

1. EQ Credit 1: Enhanced Indoor Air Quality Strategies

    a. Wall-mounted carbon dioxide sensors: accuracy in percent.

G. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.8 CLOSEOUT SUBMITTALS

A. Division 01 Section: “Execution and Closeout Requirements.” For Closeout Procedures.

B. Project Operation and Maintenance Manuals:

1. Three (3) hardbound copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall also be furnished on Compact Disc media. Operation and Maintenance Manual shall include the following:

   a. Table of contents.
   b. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system, floor, including floor plans, incorporating all information supplied with the approved submittal.
   c. Manufacturers’ product data sheets or catalog pages for all products including software.
   d. System Operator’s manuals, including inspection periods, cleaning methods, calibration procedures, etc.
   e. Archive copy of all site-specific databases and sequences.
   f. BAS network diagrams.
   g. Interfaces to all third-party products and work by other trades.
   h. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.
   i. Point to point complete checklists.
   j. Start-up and commissioning completed checklists.

1.9 QUALITY ASSURANCE AND QUALIFICATIONS

A. General:

1. The Building Management System Contractor shall be the primary manufacturer-owned branch office or certified partner that is regularly engaged in the engineering, programming, installation and service of total integrated Building Management Systems.
2. The BAS Contractor shall be a recognized national manufacturer, installer and service provider of BAS.
3. The BAS Contractor shall supply complete maintenance and support services on a 24 hour, 7-day-a-week basis.
4. As evidence and assurance of the contractor’s ability to support the Owner's system with service and parts, the contractor must have been in the BAS business for at least the last ten (10) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.
5. The Building Management System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Management Systems, and shall be the manufacturer’s latest standard of design at the time of bid.

B. Workplace Safety And Hazardous Materials:

1. Provide a safety program in compliance with the Contract Documents.

2. The BAS Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.
3. Comply with federal, state and local safety regulations.
4. Ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by the OSHA have jurisdiction for at least each topic listed in the Safety Certification Manual.
5. Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.
6. Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the Owner within the same day. Avoid the hazard area until the hazard has been eliminated.
7. Sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.
8. The safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the AHJ at the Project site.
9. The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

C. Quality Management Program:

1. Designate a competent and experienced employee to provide BAS Project Management. The designated Project Manger shall be empowered to make technical, scheduling and related decisions on behalf of the BAS Contractor. At minimum, the Project Manager shall:

   a. Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
   b. Manage the financial aspects of the BAS Contract.
   c. Coordinate as necessary with other trades.
   d. Be responsible for the work and actions of the BAS workforce on site.

1.10 PRE-SUBMITTAL MEETINGS

A. Pre-Submittal Meetings: After approval of the material and equipment list and prior to submitting equipment shop drawings, the pre-submittal coordination meeting(s) shall be held at the Owner's Office. The attendees shall include at the minimum:

1. Equipment Sales Representative responsible for the preparing the shop drawings
2. Mechanical Contractor
3. Building ATC Contractor
4. ATC Product Rep. (Sales Representative, Control Engineer, and
5. Lead Project Installation Technician)
6. Owner
7. Electrical Contractor
8. Mechanical Engineer

B. The Equipment Representative and/or the Mechanical Contractor shall be responsible for e-mailing, a minimum of 48 hours in advance, a copy of the Preliminary Submittal to all named parties. The purpose of the meeting is to coordinate requirements and gain a full understanding form all parties as to what is required for a fully turnkey installation, as well as to minimize potential

rejection of shop drawings. The Mechanical Contractor shall coordinate these meetings and shall document and publish minutes of all meetings."

1.11 COORDINATION

A. The demarcation of work and responsibilities between the BAS Contractor and other related trades shall be as outlined in the BAS RESPONSIBILITY MATRIX

BAS RESPONSIBILITY MATRIX				
WORK	FURNISH	INSTALL	Low Volt. WIRING/TUBE	LINE POWER
BAS low voltage and communication wiring	BAS	BAS	BAS	N/A
BAS conduits and raceway	BAS	BAS	BAS	BAS
Automatic dampers	BAS	*	BAS	BAS
BAS control panels	BAS	BAS	BAS	BAS
Automatic valves	BAS	*	BAS	N/A
BAS Current Switches.	BAS	BAS	BAS	BAS
BAS Control Relays	BAS	BAS	BAS	BAS
Power distribution system monitoring interfaces	**	**	BAS	**
All BAS Nodes, equipment, housings, enclosures and panels.	BAS	BAS	BAS	BAS
Smoke Detectors	*	*	BAS	**
VFDs	*	*	BAS	**
Refrigerant monitors	*	BAS	BAS	**
Fire Alarm shutdown relay interlock wiring	**	**	**	**
Unit Heater controls	BAS	BAS	BAS	BAS
Packaged RTU space mounted controls	*	BAS	BAS	BAS
Packaged RTU factory-mounted controls	*	*	BAS	BAS
Packaged RTU field-mounted controls	BAS	BAS	BAS	BAS
Starters, HOA switches	**	**	N/A	BAS
Control damper actuators	BAS	BAS	BAS	BAS

Symbols: * HVAC Systems Installer

** Electric Systems Installer

1.12 DELIVERY, STORAGE, AND HANDLING

A. Refer to Division 01 Section: “Product Requirements”: Product storage and handling requirements.

B. Accept controls on site in original factory packaging Inspect for damage.

1.13 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.14 WARRANTY

A. Refer to Division 01 Section: “Execution and Closeout Requirements”: Product warranties and product bonds.

B. Standard Material and Labor Warranty:

1. Provide a two-year labor and material warranty on the BAS.
2. If within twelve (12) months from the date of acceptance any work is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the cost of the BAS Contractor.
3. Maintain an adequate supply of materials within 100 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be performed within 24 hour notice, 7 days per week.

C. Special Warranty

1. During the warranty period, provide up to three (3) - eight (8) hour site visits, when requested in writing by the Owner, to adjust and calibrate components and to assist the Owner in making program changes, adjusting sensors, controls, etc.

1.15 MAINTENANCE SERVICE

A. Division 01 Section: “Execution and Closeout Requirements”: Requirements for maintenance service.

B. Furnish service and maintenance of control systems for one year from Date of Substantial Completion.

C. Furnish complete service of controls systems, including callbacks. Make minimum of eight complete normal inspections of approximately four hours duration in addition to normal service calls to inspect, calibrate, and adjust controls. Submit written report after each inspection.

D. Furnish four complete inspections per year, one in each season, to inspect, calibrate, and adjust controls. Submit written report after each inspection.

E. Examine unit components monthly. Clean, adjust, and lubricate equipment.

F. Include systematic examination, adjustment, and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.

G. Perform work without removing units from service during building normal occupied hours.

H. Provide emergency call back service at all hours for this maintenance period.

I. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.

J. Perform maintenance work using competent and qualified personnel under supervision of manufacturer or original installer.

K. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

1.16 SOFTWARE OWNERSHIP

A. The Owner shall have full ownership and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BAS.

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION:

A. The Building Management System (BAS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BAS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.

B. The Building Management System shall consist of the following:

1. Standalone Network Automation Engine(s)/Server(s)
2. Field Equipment Controller(s)
3. Input/Output Module(s)
4. Local Display Device(s)
5. Portable Operator's Terminal(s)
6. Distributed User Interface(s)
7. Network processing, data storage and communications equipment
8. Other components required for a complete and working BAS

C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

E. Uninterruptible Power Supplies (UPS)

1. Provide UPS back-up for all servers, Network Automation Engines/Servers, Building Controllers, Equipment Controllers,etc. serving HVAC equipment and systems which are supplied by an emergency generator and/or emergency back-up power.

F. Acceptable Manufacturers:

1. Johnson Controls, Metasys Factory Branch
2. Honeywell, Enterprise Building Integrator (EBI)

2.2 BAS ARCHITECTURE

A. Automation Network:

1. The automation network shall be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard “off the shelf” products available through normal PC vendor channels.
2. The BAS shall network multiple user interface clients, automation engines, system controllers and application-specific controllers. Provide application and data server(s) as required for systems operation.
3. The automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
4. Network Automation Engines (NAE)/Servers shall reside on the automation network.
5. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.

B. Control Network:

1. Network Automation Engines/Servers shall provide supervisory control over the control network and shall support a minimum of three (3) of the following communication protocols:

   a. BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9.
   b. LonWorks enabled devices using the Free Topology Transceiver (FTT-10a).
   c. Modbus TCP, client and server serial, RS-485, master or slave.
   d. The Johnson Controls N2 Field Bus.
2. Control networks shall provide either “Peer-to-Peer,” Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 38k baud.
3. DDC Controllers shall reside on the control network.
4. Control network communication protocol shall be BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135.

5. A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
6. The Conformance Statements shall be submitted 10 day prior to bidding.

C. Integration:

1. Hardwired:

   a. Analog and digital signal values shall be passed from one system to another via hardwired connections.
   b. There will be one separate physical point on each system for each point to be integrated between the systems.
2. Direct Protocol (Integrator Panel):

   a. The BAS system shall include appropriate hardware equipment and software to allow bi-directional data communications between the BAS system and 3rd party manufacturers' control panels. The BAS shall receive, react to, and return information from multiple building systems, including but not limited to the chillers, boilers, variable frequency drives, power monitoring system, and medical gas.
   b. All data required by the application shall be mapped into the Automation Engine's/Server's database, and shall be transparent to the operator.
   c. Point inputs and outputs from the third-party controllers shall have real-time interoperability with BAS software features such as: Control Software, Energy Management, Custom Process Programming, Alarm Management, Historical Data and Trend Analysis, Totalization, and Local Area Network Communications.
3. BACnet Protocol Integration – BACnet:

   a. The neutral protocol used between systems will be BACnet over Ethernet and comply with the ASHRAE BACnet standard 135-2003.
   b. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
4. The ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems shall be provided.

2.3 USER INTERFACE

A. Dedicated Web Based User Interface:

1. The BAS Contractor shall provide and install a personal computer for command entry, information management, network alarm management, and database management functions. All real-time control functions, including graphics, scheduling, history collection and alarming, shall be resident in the BAS Network Automation Engines/Server to facilitate greater fault tolerance and reliability. Coordinate location for personal computer with Owner/Maintenance personnel.
2. Dedicated User Interface Architecture – The architecture of the computer shall be implemented to conform to industry standards, so that it can accommodate applications provided by the BAS Contractor and by other third party applications suppliers, including but not limited to Microsoft Office Applications. Specifically it must be implemented to conform to the following interface standards.

   a. Microsoft Internet Explorer for user interface functions

b. Microsoft Office Professional for creation, modification and maintenance of reports, sequences other necessary building management functions
c. Microsoft Outlook or other e-mail program for supplemental alarm functionality and communication of system events, and reports
d. Required network operating system for exchange of data and network functions such as printing of reports, trends and specific system summaries.

3. PC Hardware – The personal computer(s) shall be configured as follows:

a. Memory – 8 GB
b. CPU– 4 Quad Core processor. 3.6 GHz Clock Speed
c. Hard Drive – 500 GB free hard drive space
d. Hard drive backup system – DVD/RW, BluRay, LED display or network backup software provided by IT department
e. DVD/Blu-ray Drive – 16X performance
f. Ports – (1) Serial and (4) USB ports
g. Keyboard – 101 Keyboard and 2 Button Mouse
h. Monitors: 1-2 LED touchscreen display as follows:
   1) Each Display – 17” 1920 x 1080 resolution.
   2) DVI, HDMI, or Display Port interface.
   3) Display card with multiple monitor support and the above interfaces.
i. LAN communications 1 GB – Ethernet interface.

4. Operating System Software:

a. Windows 10 Professional 64 bit to support software.
b. Where user interface is not provided via browser, provide complete operator workstation software package, including any hardware or software keys. Include the original installation disks and licenses for all included software, device drivers, and peripherals.
c. Provide software registration cards to the Owner for all included software.

5. Peripheral Hardware:

a. Reports printer:
   1) Printer Make – Hewlett Packard DeskJet or equivalent Color printer.
   2) Print Quality – 600 DPI Black, 600 DPI Color
   3) Buffer minimum – 256 K Input Print Buffer.

B. Distributed Web Based User Interface :

1. All features and functions of the dedicated user interface previously defined in this document shall be available on any computer connected directly or via a wide area or virtual private network (WAN/VPN) to the automation network and conforming to the following specifications.
2. The software shall run on the Microsoft Internet Explorer browser.

C. User Interface Application Components:

1. Operator Interface:

a. An integrated browser based client application shall be used as the user operator interface program.
b. All Inputs, Outputs, Setpoints, and all other parameters as defined within Part 3, shown on the design drawings, or required as part of the system software, shall be displayed for operator viewing and modification from the operator interface software.

c. The user interface software shall provide help menus and instructions for each operation and/or application.
d. All controller software operating parameters shall be displayed for the operator to view/modify from the user interface. These include: setpoints, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.
e. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
    1) User access for selective information retrieval and control command execution.
    2) Monitoring and reporting.
    3) Alarm, non-normal, and return to normal condition annunciation.
    4) Selective operator override and other control actions.
    5) Information archiving, manipulation, formatting, display and reporting.
    6) FMS internal performance supervision and diagnostics.
    7) On-line access to user HELP menus.
    8) On-line access to current FMS as-built records and documentation.
    9) Means for the controlled re-programming, re-configuration of FMS operation and for the manipulation of FMS database information in compliance with the prevailing codes, approvals and regulations for individual FMS applications.
f. The operation of the control system shall be independent of the user interface, which shall be used for operator communications only. Systems that rely on an operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.

2. Navigation Trees:

    a. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the networks.
    b. Provide the ability for the operator to add custom trees. The operator will be able to define any logical grouping of systems or points and arrange them on the tree in any order. It shall be possible to nest groups within other groups. Provide at minimum 5 levels of nesting.
    c. The navigation trees shall be “dockable” to other displays in the user interface such as graphics. This means that the trees will appear as part of the display, but can be detached and then minimized to the Windows task bar or closed altogether. A simple keystroke will reattach the navigation to the primary display of the user interface.

3. Alarms:

    a. Alarms shall be routed directly from Network Automation Engines/Servers to supervisory PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:
        1) Log date and time of alarm occurrence.
        2) Generate a “Pop-Up” window, with audible alarm, informing a user that an alarm has been received.
        3) Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
        4) Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.

5) Provide the ability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.
6) Any attribute of any object in the system may be designated to report an alarm.

b. The FMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions
c. The FMS shall annunciate application alarms at minimum, as required by Part 3.

4. Reports and Summaries:

a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:
1) All points in the BAS.
2) All points in each BAS application.
3) All points in a specific controller.
4) All points in a user-defined group of points.
5) All points currently in alarm.
6) All points locked out.
7) All BAS schedules.
8) All user defined and adjustable variables, schedules, interlocks and the like.
b. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.
c. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.
d. The system shall allow for the creation of custom reports and queries via a standard web services XML interface and commercial off-the-shelf software such as Microsoft Access, Microsoft Excel, or Crystal Reports.

5. Schedules:

a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:
1) Weekly schedules.
2) Exception Schedules.
3) Monthly calendars.
b. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
c. It shall be possible to define one or more exception schedules for each schedule including references to calendars
d. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of five years in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the exception schedules.
e. Changes to schedules made from the User Interface shall directly modify the Network Automation Engine schedule database.
f. Schedules and Calendars shall comply with ASHRAE SP135/2003 BACnet Standard.
g. Selection of a single menu item or tool bar button shall print any displayed schedule on the system printer for use as a building management and diagnostics tool.

6. Password:

a. Multiple-level password access protection shall be provided to allow the user/manager to user interface control, display, and database manipulation capabilities deemed appropriate for each user, based on an assigned password.
b. Each user shall have the following: a user name (24 characters minimum), a password (12 characters minimum), and access levels.
c. The system shall allow each user to change his or her password at will.
d. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
e. A minimum of five levels of access shall be supported individually or in any combination as follows:
    1) Level 1 = View Data
    2) Level 2 = Command
    3) Level 3 = Operator Overrides
    4) Level 4 = Database Modification
    5) Level 5 = Database Configuration
    6) Level 6 = All privileges, including Password Add/Modify
f. A minimum of 100 unique passwords shall be supported.
g. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
h. The system shall automatically generate a report of log-on/log-off and system activity for each user. Any action that results in a change in the operation or configuration of the control system shall be recorded, including: modification of point values, schedules or history collection parameters, and all changes to the alarm management system, including the acknowledgment and deletion of alarms.

7. Screen Manager - The User Interface shall be provided with screen management capabilities that allow the user to activate, close, and simultaneously manipulate a minimum of 4 active display windows plus a network or user defined navigation tree.
8. Dynamic Color Graphics:

a. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.
b. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed.
c. The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.
d. Graphics runtime functions – A maximum of 16 graphic applications shall be able to execute at any one time on a user interface or workstation with 4 visible to the user. Each graphic application shall be capable of the following functions:
    1) All graphics shall be fully scalable
    2) The graphics shall support a maintained aspect ratio.
    3) Multiple fonts shall be supported.
    4) Unique background shall be assignable on a per graphic basis.
    5) The color of all animations and values on displays shall indicate if the status of the object attribute.
e. Operation from graphics – It shall be possible to change values (setpoints) and states in system controlled equipment by using drop-down windows accessible via the pointing device
f. Graphic editing tool – A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all animations, and defining all runtime binding.

1) The graphic editing tool shall in general provide for the creation and positioning of point objects by dragging from tool bars or drop-downs and positioning where required.
2) In addition, the graphic editing tool shall be able to add additional content to any graphic by importing backgrounds in the SVG, BMP, PNG or JPG file formats.

g. Aliasing – Many graphic displays representing part of a building and various building components are exact duplicates, with the exception that the various variables are bound to different field values. Consequently, it shall be possible to bind the value of a graphic display to aliases, as opposed to the physical field tags.

9. Historical trending and data collection:

a. Each Automation Engine/Server shall store trend and point history data for all analog and digital inputs and outputs, as follows:
1) Any point, physical or calculated, may be designated for trending. Three methods of collection shall be allowed:
a) Defined time interval
b) Upon a change of value
2) Each Automation Engine/Server shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.

10. Trend data viewing and analysis:

a. Provide a trend viewing utility that shall have access to all database points.
b. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.
c. The trend viewing utility shall have the capability to define trend study displays to include multiple trends
d. Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.
e. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.
f. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.
g. Trend studies shall be capable of calculating and displaying calculated variables including highest value, lowest value and time based accumulation.

D. Portable Operator Terminal:

1. For systems that do not provide full access to systems configuration and definition via the Browser Based user interface the BAS Contractor shall provide a portable operator terminal for programming purposes. The terminal shall be configured as follows:

a. Personal Laptop Computer Manufacturer – Dell, Microsoft, or HP.
b. 8 GB RAM – Windows 10
c. 3.6 GHz Clock Speed quad-core processor.
d. 500 GB Hard Drive.
e. DVD-RW Drive, 32x speed.
f. (1) Serial (4) USB ports.
g. 1 Keyboard with 83 keys (minimum).
h. Integral 2 button Track Point or Track Ball.
i. 13” 1920x1080 resolution color display.

j. Ethernet LAN card.
k. Complete operator workstation software package, including any hardware or software.
l. Original printed manuals for all software and peripherals.
m. Original installation disks or CD for all software, device drivers, and peripherals.
n. Software registration cards for all included software shall be provided to the Owner.
o. Carrying case.
p. Spare battery.
q. External power supply/battery charger.

2. Proprietary Portable Terminal:

   a. Manufacturers providing proprietary portable terminals shall submit technical data sheets for the terminal and all associated software and hardware.
   b. The proprietary terminal shall meet the same operator interface software requirements as specified above.

3. Software:

   a. Portable operator terminals shall support all controllers within the system on a direct-connect communications basis.
   b. When used to access First or Second Tier controllers, the portable operator terminal shall utilize the standard operator workstation software, as previously defined.
   c. When used to access Application Specific Controllers, the portable operator terminal shall utilize either the standard operator workstation software, as previously defined, or controller-specific utility software.

2.4 NETWORK AUTOMATION ENGINES (NAE) / AUTOMATION SERVERS (AS)

A. Network Automation Engine (NAE) / Automation Server (AS):

1. The Network Automation Engine (NAE)/Automation Server (AS) shall be a fully user-programmable, supervisory controller. The NAE/AS shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines/Automation Servers.
2. Automation network – The NAE/AS shall reside on the automation network and shall support a subnet of system controllers.
3. User Interface – Each NAE/AS shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.

   a. The web based UI software shall be imbedded in the NAE/AS. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
   b. The NAE/AS shall support up four (4) concurrent users.
   c. The web based user shall have the capability to access all system data through one NAE/AS.
   d. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one NAE/AS.
   e. Systems that require the user to address more than one NAE/AS to access all system information are not acceptable.
   f. The NAE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NAE/AS.

g. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
h. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer and shall be independent of any JAVA applications and services, preferred graphical format shall be HTML5:
   1) Configuration
   2) Commissioning
   3) Data Archiving
   4) Monitoring
   5) Commanding
   6) System Diagnostics
i. Systems that require workstation software or modified web browsers are not acceptable.
j. The NAE/AS shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.

4. Processor – The NAE/AS shall be microprocessor-based with a minimum word size of 32 bits. The NAE/AS shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE/AS size and capability shall be sufficient to fully meet the requirements of this Specification.
5. Memory – Each NAE/AS shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
6. Hardware Real Time Clock – The NAE/AS shall include an integrated, hardware-based, real-time clock.
7. The NAE/AS shall include troubleshooting LED indicators to identify the following conditions:

   a. Power - On/Off
   b. Ethernet Traffic – Ethernet Traffic/No Ethernet Traffic
   c. Ethernet Connection Speed – 10 Mbps/100 Mbps
   d. FC Bus – Normal Communications/No Field Communications
   e. Peer Communication – Data Traffic Between NAE Devices
   f. Run – NAE/AS Running/NAE/AS In Startup/NAE/AS Shutting Down/Software Not Running
   g. Bat Fault – Battery Defective, Data Protection Battery Not Installed
   h. Fault – General Fault
   i. Modem RX – NAE/AS Modem Receiving Data
   j. Modem TX – NAE/AS Modem Transmitting Data
8. Communications Ports – The NAE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals:

   a. Up to two (2) USB port
   b. Up to two (2) RS-485 port
   c. Two (2) Ethernet port
9. Diagnostics – The NAE/AS shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine/Server shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
10. Power Failure – In the event of the loss of normal power, The NAE/AS shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an

orderly shutdown of all programs to prevent the loss of database or operating system software.

a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

11. Certification – The NAE/AS shall be listed by Underwriters Laboratories (UL).
12. Controller network – The NAE/AS shall support the following communication protocols on the controller network:

a. The NAE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
   1) A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
   2) The Conformance Statements shall be submitted 10 day prior to bidding.
   3) The NAE/AS shall support a minimum of 100 control devices.
b. The NAE/AS shall support LonWorks enabled devices using the Free Topology Transceiver FTT10.
   1) All LonWorks controls devices shall be LonMark certified.
   2) The NAE/AS shall support a minimum of 64 LonWorks enabled control devices.
c. The NAE/AS shall support the Johnson Controls N2 Field Bus.
   1) The Bus shall conform to Electronic Industry Alliance (EIA) Standard RS-485.
   2) The Bus shall employ a master/slave protocol where the NAE/AS is the master.
   3) The Bus shall employ a four (4) level priority system for polling frequency.
   4) The Bus shall be optically isolated from the NAE/AS.

2.5 OPERATING SYSTEM SOFTWARE

A. Input/output Capability From Operator Station:

1. Request display of current values or status in tabular or graphic format.
2. Command selected equipment to specified state.
3. Initiate logs and reports.
4. Change analog limits.
5. Add, delete, or change points within each control unit or application routine.
6. Change point input/output descriptors, status, alarm descriptors, and unit descriptors.
7. Add new control units to system.
8. Modify and set up maintenance scheduling parameters.
9. Develop, modify, delete or display full range of color graphic displays.
10. Automatically archive select data even when running third party software.
11. Capability to sort and extract data from archived files and to generate custom reports.
12. Support two printer operations.
13. Alarm printer: Print alarms, operator acknowledgments, action messages, system alarms, operator sign-on and sign-off.
14. Data printer: Print reports, page prints, and data base prints.

15. Select daily, weekly or monthly as scheduled frequency to synchronize time and date in digital control units. Accommodate daylight savings time adjustments.
16. Print selected control unit database.

B. Operator System Access: Via software password with minimum 30 access levels at work station and minimum 3 access levels at each control unit.

C. Data Base Creation and Support: Use standard procedures for changes. Control unit automatically checks workstation data base files upon connection and verify data base match. Include the following minimum capabilities:

1. Add and delete points.
2. Modify point parameters.
3. Change, add, or delete English language descriptors.
4. Add, modify, or delete alarm limits.
5. Add, modify, or delete points in start/stop programs, trend logs, and other items.
6. Create custom relationship between points.
7. Create or modify DDC loops and parameters.
8. Create or modify override parameters.
9. Add, modify, and delete applications programs.
10. Add, delete, develop, or modify dynamic color graphic displays.

D. Dynamic Color Graphic Displays:

1. Utilizes custom symbols or system supported library of symbols.
2. Sixteen (16) colors.
3. Sixty (60) outputs of real-time live dynamic data for each graphic.
4. Dynamic graphic data.
5. 1,000 separate graphic pages.
6. Modify graphic screen refresh rate between 1 and 60 seconds.

E. Operator Station:

1. Accept data from LAN as needed without scanning entire network for updated point data.
2. Interrogate LAN for updated point data when requested.
3. Allow operator command of devices.
4. Allow operator to place specific control units in or out of service.
5. Allow parameter editing of control units.
6. Store duplicate data base for every control unit and allow down loading while system is on line.
7. Control or modify specific programs.
8. Develop, store and modify dynamic color graphics.
9. Data archiving of assigned points and support overlay graphing of this data using up to four (4) variables.

F. Alarm Processing:

1. Off normal condition: Cause alarm and appropriate message, including time, system, point descriptor, and alarm condition. Select alarm state or value and alarms causing automatic dial-out.
2. Critical alarm or change-of-state: Display message, stored on disk for review and sort, or print.

3. Print on line changeable message, up to 60 characters in length, for each alarm point specified.
4. Display alarm reports on video. Display multiple alarms in order of occurrence.
5. Define time delay for equipment start-up or shutdown.
6. Allow unique routing of specific alarms.
7. Operator specifies when alarm requires acknowledgment.
8. Continue to indicate unacknowledged alarms after return to normal.
9. Alarm notification:
10. Print automatically.
11. Display indicating alarm condition.
12. Selectable audible alarm indication.

G. Event Processing: Automatically initiate commands, user defined messages, take specific control actions or change control strategy and application programs resulting from event condition. Event condition may be value crossing operator defined limit, change of state, specified state, or alarm occurrence or return to normal.

H. Automatic Restart: Automatically start field equipment on restoration of power. Furnish time delay between individual equipment restart and time of day start/stop.

I. Messages:

1. Automatically display or print user-defined message subsequent to occurrence of selected events.
2. Compose, change, or delete message.
3. Display or log message at any time.
4. Assign any message to event.

J. Reports:

1. Manually requested with time and date.
2. Long term data archiving to hard disk.
3. Automatic directives to download to transportable media including floppy diskettes for storage.
4. Data selection methods to include data base search and manipulation.
5. Data extraction with mathematical manipulation.
6. Data reports to allow development of XY curve plotting, tabular reports (both statistical and summary), and multi-point timed based plots with not less than four (4) variables displayed.
7. Generating reports either normally at operator direction, or automatically under workstation direction.
8. Either manually display or print reports. Automatically print reports on daily, weekly, monthly, yearly or scheduled basis.
9. Include capability for statistical data manipulation and extraction.
10. Capability to generate four types of reports: Statistical detail reports, summary reports, trend graphic plots, x-y graphic plots.

K. Parameter Save/Restore: Store most current operating system, parameter changes, and modifications on disk or diskette.

L. Data Collection:

1. Automatically collect and store in disk files.

2. Daily electrical energy consumption, peak demand, and time of peak demand for up to electrical meters over 2-year period.
3. Daily consumption for up to 30 meters over a 2 year period.
4. Daily billable electrical energy consumption and time for up to 1024 zones over a 10 year period.
5. Archiving of stored data for use with system supplied custom reports.

M. Graphic Display: Support graphic development on work station with software features:

1. Page linking.
2. Generate, store, and retrieve library symbols.
3. Single or double height characters.
4. Sixty (60) dynamic points of data for each graphic page.
5. Pixel level resolution.
6. Animated graphics for discrete points.
7. Analog bar graphs.
8. Display real time value of each input or output line diagram fashion.

N. Maintenance Management:

1. Run time monitoring, for each point.
2. Maintenance scheduling targets with automatic annunciation, scheduling and shutdown.
3. Equipment safety targets.
4. Display of maintenance material and estimated labor.
5. Target point reset, for each point.

O. Advisories:

1. Summary containing status of points in locked out condition.
2. Continuous operational or not operational report of interrogation of system hardware and programmable control units for failure.
3. Report of power failure detection, time and date.
4. Report of communication failure with operator device, field interface unit, point and programmable control unit.

2.6 LOAD CONTROL PROGRAMS

A. General: Support inch-pounds and S.I. metric units of measurement.

B. Demand Limiting:

1. Monitor total power consumption for each power meter and shed associated loads automatically to reduce power consumption to an operator set maximum demand level.
2. Input: Pulse count from incoming power meter connected to pulse accumulator in control unit.
3. Forecast demand (kW): Predicted by sliding window method.
4. Automatically shed loads throughout the demand interval selecting loads with independently adjustable on and off time of between one and 255 minutes.
5. Demand Target: Minimum of 3 for each demand meter; change targets based upon (1) time, (2) status of pre-selected points, or (3) temperature.
6. Load: Assign load shed priority, minimum "ON" time and maximum "OFF" time.
7. Limits: Include control band (upper and lower limits).

8. Output advisory when loads are not available to satisfy required shed quantity, advise shed requirements and requiring operator acknowledgment.

C. Duty Cycling:

1. Periodically stop and start loads, based on space temperature, and according to various On/Off patterns.
2. Modify off portion of cycle based on operator specified comfort parameters. Maintain total cycle time by increasing on portion of cycle by equal quantity off portion is reduced.
3. Set and modify following parameters for each individual load.

    a. Minimum and maximum off time.
    b. On/Off time in one-minute increments.
    c. Time period from beginning of interval until cycling of load.
    d. Manually override the DDC program and place a load in an On or Off state.
    e. Cooling Target Temperature and Differential.
    f. Heating Target Temperature and Differential.
    g. Cycle off adjustment.

D. Automatic Time Scheduling:

1. Self-contained programs for automatic start/stop/scheduling of building loads.
2. Support up to seven (7) normal day schedules, seven (7) "special day" schedules and two (2) temporary day schedules.
3. Special day’s schedule supporting up to 30 unique date/duration combinations.
4. Number of loads assigned to time program; with each load having individual time program.
5. Each load assigned at least 16 control actions for each day with 1 minute resolution.
6. Furnish the following time schedule operations:

    a. Start.
    b. Optimized Start.
    c. Stop.
    d. Optimized Stop.
    e. Cycle.
    f. Optimized Cycle.
7. Capable of specifying minimum of 30 holiday periods up to 100 days in length for the year.
8. Create temporary schedules.
9. Broadcast temporary "special day" date and duration.

E. Start/Stop Time Optimization:

1. Perform optimized start/stop as function of outside conditions, inside conditions, or both.
2. Adaptive and self-tuning, adjusting to changing conditions unattended.
3. For each point under control, establish and modify:

    a. Occupancy period.
    b. Desired temperature at beginning of occupancy period.
    c. Desired temperature at end of occupancy period.

F. Night Setback/Setup Program: Reduce heating space temperature set point or raise cooling space temperature set-point during unoccupied hours; in conjunction with scheduled start/stop and optimum start/stop programs.

G. Calculated Points: Define calculations and totals computed from monitored points (analog/digital points), constants, or other calculated points.

1. Employ arithmetic, algebraic, Boolean, and special function operations.
2. Treat calculated values like any other analog value; use for any function where a "hard wired point" might be used.

H. Event Initiated Programming: Any data point capable of initiating event, causing series of controls in a sequence.

1. Define time interval between each control action between 0 to 3600 seconds.
2. Output may be analog value.
3. Provide for "skip" logic.
4. Verify completion of one action before proceeding to next action. When not verified, program capable of skipping to next action.

I. Direct Digital Control: Furnish with each control unit Direct Digital Control software so operator is capable of customizing control strategies and sequences of operation by defining appropriate control loop algorithms and choosing optimum loop parameters.

1. Control loops: Defined using "modules" are analogous to standard control devices.
2. Output: Paired or individual digital outputs for pulse width modulation, and analog outputs.
3. Firmware:

    a. PID with analog or pulse-width modulation output.
    b. Floating control with pulse-width modulated outputs.
    c. Two-position control.
    d. Primary and secondary reset schedule selector.
    e. Hi/Low signal selector.
    f. Single pole double-throw relay.
    g. Single pole double throw time delay relay with delay before break, delay before make and interval time capabilities.
4. Direct Digital Control loop: Downloaded upon creation or on operator request. On sensor failure, program executes user defined failsafe output.
5. Display: Value or state of each of lines interconnecting DDC modules.

J. Fine Tuning Direct Digital Control PID or floating loops:

1. Display information:

    a. Control loop being tuned.
    b. Input (process) variable.
    c. Output (control) variable.
    d. Set-point of loop.
    e. Proportional band.
    f. Integral (reset) Interval.
    g. Derivative (rate) Interval.

2. Display format: Graphic, with automatic scaling; with input and output variable superimposed on graph of "time" versus "variable".

K. Trend logging:

1. Each control unit capable of storing samples of control unit's data points.
2. Update file continuously at operator assigned intervals.
3. Automatically initiate upload requests and then stores data on hard disk.
4. Time synchronize sampling at operator specified times and intervals with sample resolution of one minute.
5. Co-ordinate sampling with specified on/off point- state.
6. Display trend samples on workstation in graphic format. Automatically scale trend graph with minimum 60 samples of data in plot of time versus data.

2.7 HVAC CONTROL PROGRAMS

A. General:

1. Support Inch-pounds and S.I. metric units of measurement.
2. Identify each HVAC Control system.

B. Optimal Run Time:

1. Control start-up and shutdown times of HVAC equipment for both heating and cooling.
2. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
3. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.
4. Use outside air temperature to determine early shut down with ventilation override.
5. Analyze multiple building mass sensors to determine seasonal mode and worse case condition for each day.
6. Operator commands:

    a. Define term schedule.
    b. Add/delete fan status point.
    c. Add/delete outside air temperature point.
    d. Add/delete mass temperature point.
    e. Define heating/cooling parameters.
    f. Define mass sensor heating/cooling parameters.
    g. Lock/unlock program.
    h. Request optimal run-time control summary.
    i. Request optimal run-time mass temperature summary.
    j. Request HVAC point summary.
    k. Request HVAC saving profile summary.
7. Control Summary:

    a. HVAC Control system begin/end status.
    b. Optimal run time lock/unlock control status.
    c. Heating/cooling mode status.
    d. Optimal run time schedule.
    e. Start/Stop times.

f. Selected mass temperature point ID.
g. Optimal run-time system normal start-times.
h. Occupancy and vacancy times.
i. Optimal run time system heating/cooling mode parameters.

8. Mass temperature summary:

a. Mass temperature point type and ID.
b. Desired and current mass temperature values.
c. Calculated warm-up/cool-down time for each mass temperature.
d. Heating/cooling season limits.
e. Break point temperature for cooling mode analysis.

9. HVAC point summary:

a. Control system identifier and status.
b. Point ID and status.
c. Outside air temperature point ID and status.
d. Mass temperature point ID and status.
e. Calculated optimal start and stop times.
f. Period start.

C. Enthalpy Switchover:

1. Calculate outside and return air enthalpy using measured temperature and relative humidity; determine energy expended and control outside and return air dampers.
2. Operator commands:

a. Add/delete fan status point.
b. Add/delete outside air temperature point.
c. Add/delete discharge controller point.
d. Define discharge controller parameters.
e. Add/delete return air temperature point.
f. Add/delete outside air dewpoint/humidity point.
g. Add/delete return air dewpoint/humidity point.
h. Add/delete damper switch.
i. Add/delete minimum outside air.
j. Add/delete atmospheric pressure.
k. Add/delete heating override switch.
l. Add/delete evaporative cooling switch.
m. Add/delete air flow rate.
n. Define enthalpy deadband.
o. Lock/unlock program.
p. Request control summary.
q. Request HVAC point summary.

3. Control summary:

a. HVAC control system begin/end status.
b. Enthalpy switchover optimal system status.
c. Optimal return time system status.
d. Current outside air enthalpy.
e. Calculated mixed air enthalpy.
f. Calculated cooling cool enthalpy using outside air.
g. Calculated cooling cool enthalpy using mixed air.
h. Calculated enthalpy difference.

i. Enthalpy switchover deadband.
j. Status of damper mode switch.

2.8 PROGRAMMING APPLICATION FEATURES

A. Trend Point:

1. Sample multiple points, real or computed, with each point capable of collecting all samples at intervals specified in minutes, hours, days, or month.
2. Output trend logs as line-graphs or bar graphs. Output graphic on terminal, with each point for line and bar graphs designated with a unique pattern and color, vertical scale either actual values or percent of range, and horizontal scale time base. Print trend logs up to 12 columns of one point/column.

B. Alarm Messages:

1. Allow definition of multiple messages, each having minimum length of 120 characters for each individual message.
2. Assign alarm messages to system messages including point's alarm condition, point's off-normal condition, totaled point's warning limit, hardware elements advisories.
3. Output assigned alarm with "message requiring acknowledgment".
4. Operator commands include define, modify, or delete; output summary listing current alarms and assignments; output summary defining assigned points.

C. Weekly Scheduling:

1. Automatically initiate equipment or system commands, based on selected time schedule for points specified.
2. Program times for each day of week, for each point, with one minute resolution.
3. Automatically generate alarm output for points not responding to command.
4. Allow for holidays, minimum of 366 consecutive holidays.
5. Operator commands:

   a. System logs and summaries.
   b. Start of stop point.
   c. Lock or unlock control or alarm input.
   d. Add, delete, or modify analog limits and differentials.
   e. Adjust point operation position.
   f. Change point operational mode.
   g. Open or close point.
   h. Enable/disable, lock/unlock, or execute interlock sequence or computation profile.
   i. Begin or end point totals.
   j. Modify total values and limits.
   k. Access or secure point.
   l. Begin or end HVAC or load control system.
   m. Modify load parameter.
   n. Modify demand limiting and duty cycle targets.
6. Output summary: Listing of programmed function points, associated program times, and respective day of week programmed points by software groups or time of day.

D. Interlocking:

1. Permit events to occur, based on changing condition of one or more associated master points.
2. Binary contact, high/low limit of analog point or computed point capable of being used as master. Master capable of monitoring or commanding multiple slaves.
3. Operator commands:

    a. Define single master/multiple master interlock process.
    b. Define logic interlock process.
    c. Lock/unlock program.
    d. Enable/disable interlock process.
    e. Execute terminate interlock process.
    f. Request interlock type summary.

2.9 DDC SYSTEM CONTROLLERS

A. Field Equipment Controller (FEC):

1. The Field Equipment Controller (FEC) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.
2. The FEC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
3. Controllers shall be factory/field programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately.
4. The FEC shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
5. The FEC shall include a removable base to allow pre-wiring without the controller.
6. The FEC shall include troubleshooting LED indicators to identify the following conditions:

    a. Power On
    b. Power Off
    c. Download or Startup in progress, not ready for normal operation
    d. No Faults
    e. Device Fault
    f. Field Controller Bus - Normal Data Transmission
    g. Field Controller Bus - No Data Transmission
    h. Field Controller Bus - No Communication
    i. Sensor-Actuator Bus - Normal Data Transmission
    j. Sensor-Actuator Bus - No Data Transmission
    k. Sensor-Actuator Bus - No Communication
7. The FEC shall accommodate the direct wiring of analog and binary I/O field points.
8. The FEC shall support the following types of inputs and outputs:

    a. Universal Inputs - shall be configured to monitor any of the following:
        1) Analog Input, Voltage Mode
        2) Analog Input, Current Mode
        3) Analog Input, Resistive Mode
        4) Binary Input, Dry Contact Maintained Mode
        5) Binary Input, Pulse Counter Mode
    b. Binary Inputs - shall be configured to monitor either of the following:

1) Dry Contact Maintained Mode
2) Pulse Counter Mode

c. Analog Outputs - shall be configured to output either of the following
1) Analog Output, Voltage Mode
2) Analog Output, current Mode

d. Binary Outputs - shall output the following:
1) 24 VAC Triac

e. Configurable Outputs - shall be capable of the following:
1) Analog Output, Voltage Mode
2) Binary Output Mode

9. The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).

a. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
b. The FC Bus shall support communications between the FECs and the NAE/AS.
c. The FC Bus shall also support Input/Output Module (IOM) communications with the FEC and with the NAE/AS.
d. The FC Bus shall support a minimum of 50 IOMs and FEC in any combination.
e. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the furthest connected device.

10. The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).

a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
b. The SA Bus shall support a minimum of 10 devices per trunk.
c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the FEC and the furthest connected device.

11. The FEC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.
12. The FEC shall support, but not be limited to, the following:

a. Hot water, chilled water/central plant applications
b. Built-up air handling units for special applications
c. Terminal units
d. Special programs as required for systems control

2.10 FIELD DEVICES

A. Input/Output Module (IOM):

1. The Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC.
2. The IOM shall communicate with the FEC over either the FC Bus or the SA Bus using BACnet Standard protocol SSPC-135, Clause 9.
3. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
4. The IOM shall have a minimum of 4 points to a maximum of 17 points.
5. The IOM shall support the following types of inputs and outputs:

a. Universal Inputs - shall be configured to monitor any of the following:
1) Analog Input, Voltage Mode

2) Analog Input, Current Mode
3) Analog Input, Resistive Mode
4) Binary Input, Dry Contact Maintained Mode
5) Binary Input, Pulse Counter Mode

b. Binary Inputs - shall be configured to monitor either of the following:
1) Dry Contact Maintained Mode
2) Pulse Counter Mode

c. Analog Outputs - shall be configured to output either of the following
1) Analog Output, Voltage Mode
2) Analog Output, current Mode

d. Binary Outputs - shall output the following:
1) 24 VAC Triac

e. Configurable Outputs - shall be capable of the following:
1) Analog Output, Voltage Mode
2) Binary Output Mode

6. The IOM shall include troubleshooting LED indicators to identify the following conditions:

a. Power On
b. Power Off
c. Download or Startup in progress, not ready for normal operation
d. No Faults
e. Device Fault
f. Normal Data Transmission
g. No Data Transmission
h. No Communication

B. Networked Thermostat (TEC):

1. The Networked Thermostats shall be capable of controlling the following:

a. A four pipe fan coil system with multi-speed fan control.
b. A pressure dependant Variable Air Volume System or similar zoning type system using reheat.
c. A two pipe fan coil with a single speed fan.

2. The Networked Thermostat shall communicate over the Field Controller Bus using BACnet Standard protocol SSPC-135, Clause 9.

a. The Networked Thermostat shall support remote read/write and parameter adjustment from the web based User Interfaceable through a Network Automation Engine.

3. The Networked Thermostat shall include an intuitive User Interface providing plain text messages.

a. Two line, 8 character backlit display
b. LED indicators for Fan, Heat, and Cool status
c. Five (5) User Interface Keys
1) Mode
2) Fan
3) Override
4) Degrees C/F
5) Up/Down

d. The display shall continuously scroll through the following parameters:
1) Room Temperature

2) System Mode
3) Schedule Status – Occupied/Unoccupied/Override
4) Applicable Alarms

4. The Networked Thermostats shall provide the flexibility to support the following inputs:

   a. Integral Indoor Air Temperature Sensor
   b. Duct Mount Air Temperature Sensor
   c. Remote Indoor Air Temperature Sensor with Occupancy Override and LED Indicator.
   d. Two configurable binary inputs

5. The Networked Thermostats shall provide the flexibility to support the following outputs:

   a. Three Speed Fan Control
   b. On/Off Control
   c. Floating Control
   d. Proportional (0 to 10V) Control

6. The Networked Thermostat shall provide a minimum of six (6) levels of keypad lockout.
7. The Networked Thermostat shall provide the flexibility to adjust the following parameters:

   a. Adjustable Temporary Occupancy from 0 to 24 hours
   b. Adjustable heating/cooling deadband from 2º F to 5º F
   c. Adjustable heating/cooling cycles per hour from 4 to 8

8. The Networked Thermostat shall employ nonvolatile electrically erasable programmable read-only memory (EEPROM) for all adjustable parameters.

C. Network Sensors (NS):

1. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:

   a. Zone Temperature
   b. Zone humidity
   c. Zone setpoint

2. The NS shall transmit the zone information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.
3. The Network Sensors shall include the following items:

   a. A backlit Liquid Crystal Display (LCD) to indicate the Temperature, Humidity and Setpoint.
   b. An LED to indicate the status of the Override feature.
   c. A button to toggle the temperature display between Fahrenheit and Celsius.
   d. A button to initiate a timed override command

4. The NS shall be available with either screw terminals or phone jack.
5. The NS shall be available in either surface mount or wall mount styles.

2.11 SYSTEM TOOLS

A. System Configuration Tool (SCT):

1. The Configuration Tool shall be a software package enabling a computer platform to be used as a stand-alone engineering configuration tool for a Network Automation Engine (NAE) or a Network Integration Engine (NIE).

2. The configuration tool shall provide an archive database for the configuration and application data.
3. The configuration tool shall have the same look-and-feel at the User Interface (UI) regardless of whether the configuration is being done online or offline.
4. The configuration tool shall include the following features:

    a. Basic system navigation tree for connected networks
    b. Integration of Metasys N1, LonWorks, and BACnet enabled devices
    c. Customized user navigation trees
    d. Point naming operating parameter setting
    e. Graphic diagram configuration
    f. Alarm and event message routing
    g. Graphical logic connector tool for custom programming
    h. Downloading, uploading, and archiving databases
5. The configuration tool shall have the capability to automatically discover field devices on connected buses and networks. Automatic discovery shall be available for the following field devices:

    a. BACnet Devices
    b. LonWorks devices
    c. N2 Bus devices
    d. Metasys N1 networks
6. The configuration tool shall be capable of programming the Field Equipment Controllers.

    a. The configuration tool shall provide the capability to configure, simulate, and commission the Field Equipment Controllers.
    b. The configuration tool shall allow the FECs to be run in Simulation Mode to verify the applications.
    c. The configuration tool shall contain a library of standard applications to be used for configuration.
7. The configuration tool shall be capable of programming the field devices.

    a. The configuration tool shall provide the capability to configure, simulate, and commission the field devices.
    b. The configuration tool shall allow the field devices to be run in Simulation Mode to verify the applications.
    c. The configuration tool shall contain a library of standard applications to be used for configuration
8. A wireless access point shall allow a wireless enabled portable PC to make a temporary Ethernet connection to the automation network.

    a. The wireless connection shall allow the PC to access configuration tool through the web browser using the User Interface (UI).
    b. The wireless use of configuration tool shall be the same as a wired connection in every respect.
    c. The wireless connection shall use the Bluetooth Wireless Technology.

B. Wireless MS/TP Converter (BTCVT):

1. The converter shall provide a temporary wireless connection between the SA or FC Bus and a wireless enabled portable PC.
2. The converter shall support downloading and troubleshooting FEC and field devices from the PC over the wireless connection.

3. The converter shall employ Bluetooth Wireless Technology.
4. The converter shall be powered through a connection to either the Sensor-Actuator (SA) or the Field Controller (FC) Bus.
5. The converter shall operate over a minimum of thirty three (33) feet within a building.
6. The converter shall have LED indicators to provide information regarding the following conditions:

    a. Power - On/Off
    b. Fault – Fault/No Fault
    c. SA/FC Bus – Bus Activity/ No Bus Activity
    d. Blue – Bluetooth Communication Established/ Bluetooth Communication Not Established
7. The SWCVT shall comply with FCC Part 15.247 regulations for low-power unlicensed transmitters.

2.12 INPUT DEVICES

A. General Requirements:

1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

B. Temperature Sensors:

1. General Requirements:

    a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
    b. All temperature devices shall use precision thermistors accurate to +/- 1 degree F over a range of -30 to 230 degrees F. Space temperature sensors shall be accurate to +/- .5 degrees F over a range of 40 to 100 degrees F.
    c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Room Temp	+ .5°F.
Duct Temperature	+ .5°F.
All Others	+ .75°F.

2. Room Temperature Sensors:

    a. Room sensors shall be constructed for either surface or wall box mounting.
    b. Room sensors shall have the following options when specified:
        1) Setpoint reset slide switch providing a +3 degree (adjustable) range.
        2) Individual heating/cooling setpoint slide switches.

3) A momentary override request push button for activation of after-hours operation.
4) Analog thermometer.

3. Room Temperature Sensors with Integral Display:

a. Room sensors shall be constructed for either surface or wall box mounting.
b. Room sensors shall have an integral LCD display and four button keypad with the following capabilities:
1) Display room and outside air temperatures.
2) Display and adjust room comfort setpoint.
3) Display and adjust fan operation status.
4) Timed override request push button with LED status for activation of after-hours operation.
5) Display controller mode.
6) Password selectable adjustment of setpoint and override modes.

4. Outside Air Sensors:

a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.

5. Duct Mount Sensors:

a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

C. Humidity Sensors:

1. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.
2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.
4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.
7. Acceptable Manufacturers: Johnson Controls, Honeywell

D. Carbon Dioxide Sensors:

1. Provide a complete installation of ETL certified to ANSI/UL 61010-1, CAN/CSA C22.2 No 61010-1, EN 61010:2010, IEC 61010:2010 IAQ Point 2 sensors which will provide continuous readings of Carbon Dioxide (CO2) and optional Temperature and Relative Humidity which will facilitate demand controlled ventilation. These sensors will be capable of interlocking with visual and audible alarms, horns, louvers, drives, VAV's, make-up air and or exhaust systems with its built in dry contacts, digital and analog outputs.

    a. Dedicated 4-20 mA output signal for each of the following parameters: CO2, Temperature and Relative Humidity to interface with the BAS. The sensor shall use Non-Dispersive Infrared sensing technology (NDIR) and be able to monitor Carbon Dioxide (CO2) concentration within two selectable ranges: 0-2000 ppm or 0-5000 ppm with an accuracy of +/- 30ppm, +/- 3% of reading at 25□C. The 1.9" H x 2.6" W multicolor touch screen display shall be easy to navigate and menu driven to allow a customizable display readings.
    b. The detector shall also be able to simultaneously monitor the ambient temperature (either in Celsius or Fahrenheit) and the Relative Humidity in addition to Carbon Dioxide levels. The temperature range shall be within +/-0.5 deg C at 25□C and 50% rH +/- 1.5 deg C over range. The relative humidity range shall be within +/-5% at 25 deg C and 50% rH.
    c. The detector's power requirements are 20 to 30 Vac or 18 to 28 Vdc (150mA minimum and 281 mA maximum). The single dry contact DPDT relay shall be rated 3A @ 250Vac / 3A @ 30Vdc.
    d. The IAQ Point 2 Carbon Dioxide detector shall have a footprint not larger than 3"x 4.6" x 1.5"(WxHxD). It shall be easily installed into an electrical box when wall-mounted and shall be also available in a duct-mount version.
    e. Acceptable Manufacturers: Honeywell Analytics, Veris Industries, GE.
2. Accuracy: Within plus or minus 10 percent.

Differential Pressure Transmitters:

3. General Pressure Transmitter Requirements:

    a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
    b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
    c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
    d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.

4. Building Differential Air Pressure Applications (-1" to +1" w.c.)

    a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
    b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
        1) -1.00 to +1.00 w.c. input differential pressure ranges. (Select range appropriate for system application)

2) 4-20 mA output.
3) Maintain accuracy up to 20 to 1 ratio turndown.
4) Reference Accuracy: +0.2% of full span.

c. Acceptable Manufacturers: Johnson Controls and Setra.

5. Low Differential Air Pressure Applications (0” to 5” w.c.)

a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
1) (0.00 - 1.00” to 5.00”) w.c. input differential pressure ranges. (Select range appropriate for system application.)
2) 4-20 mA output.
3) Maintain accuracy up to 20 to 1 ratio turndown.
4) Reference Accuracy: +0.2% of full span.
c. Acceptable Manufacturers: Johnson Controls and Setra.

6. Medium Differential Air Pressure Applications (5” to 21” w.c.)

a. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:
1) Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.
2) Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG.
3) Thermal Effects: <+.033 F.S./Deg. F. over 40°F. to 100°F. (calibrated at 70°F.).
b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
c. Acceptable manufacturers: Johnson Controls and Setra.

E. Occupancy Sensor:

1. Type: Passive infrared.
2. Mounting: Flush.
3. Accessories:

a. Time delay.
b. Daylight sensor lockout.
c. Sensitivity control.
d. 180-degree field of view, with vertical sensing adjustment.

F. Specialty Sensors:

1. CO Sensors:

a. Unit will be certified to UL 2075. Transmitter shall be manufactured in an ISO 9001-2000 production environment.
b. Transmitter can be either standalone or part of a network of transmitters.
c. Unit shall be powered by <120 Vac (standalone only)> or <24Vac/Vdc (standalone or network)>. Honeywell <E3SA/E3SAH (standalone)> or <E3SM (network) plus E3SCO (carbon monoxide cartridge)>.
d. The gas transmitter will incorporate an electrochemical cell sensor for carbon monoxide level detection. Unit sensing cell must compensate for variations in relative humidity and temperature to maintain high levels of accuracy.
e. For local activation of fans or louvers (or other equipment), on-board DPDT relays 5 A, 30 Vdc or 250 Vac (resistive load) shall be activated at programmable set points (and programmable time delays).
f. An LCD display shall provide local gas concentration readings. Transmitter shall be capable of operating within relative humidity ranges of 5-95% non-condensing and temperature ranges of -4° F to 104° F.
g. Standalone units shall include (2) DPDT Relays and a 4-20mA output.
h. Network sensors shall include (1) DPDT Relay and RS485-Modbus and bacnet MS/TP output (selectable).
i. The transmitter shall have a plug-in capability for a gas cartridge with a smart sensor capable of self-testing
j. When system is used as network of transmitters, Honeywell 301-C-DLC controller to be used. 301-C-DLC is capable of accepting up to (96) transmitters and shall include option to add bacnet IP output (-BIP version)
k. Network system must have ability to expand the number of available relays via a relay module (Honeywell 301-R8) which shall provide (8) programmable relays

2. NO_2 / Diesel Fume Gas Sensor:

a. Transmitter can be either standalone or part of a network of transmitters.
b. Unit will be powered by <120 Vac (standalone only)> or<24Vac/Vdc (standalone or network)>. Honeywell <E3SA/E3SAH (standalone)> or <E3SM (network) plus E3NO2 (nitrogen dioxide cartridge)>.
c. The gas transmitter will incorporate an electrochemical cell sensor for nitrogen dioxide level detection. Unit sensing cell must compensate for variations in relative humidity and temperature to maintain high levels of accuracy.
d. For local activation of fans or louvers (or other equipment), on-board DPDT relays 5 A, 30 Vdc or 250 Vac (resistive load) will be activated at programmable set points (and programmable time delays).
e. An LCD display shall provide local gas concentration readings. Transmitter shall be capable of operating within relative humidity ranges of 5-95% non-condensing and temperature ranges of -4° F to 104° F.
f. Unit shall be certified to ANSI/UL 61010-1 label and and UL2075. Transmitter shall be manufactured in an ISO 9001-2000 production environment.
g. Standalone units shall include (2) DPDT Relays and a 4-20mA output.
h. Network sensors shall include (1) DPDT Relay and RS485-Modbus and bacnet MS/TP output (selectable).
i. The transmitter shall have a plug-in capability for a gas cartridge with a smart sensor capable of self-testing.
j. When system is used as network of transmitters, Honeywell 301-C-DLC controller shall be used. 301-C-DLC is capable of accepting up to (96) transmitters and will include option to add bacnet IP output (-BIP version)
k. Network system shall have ability to expand the number of available relays via a relay module (Honeywell 301-R8) which shall provide (8) programmable relays

G. Air Flow Monitoring:

1. Supply and Return Fan Inlet Air Flow Measuring Stations

a. Basis of design shall be EBTRON Model GTX108-F. Comparable product as manufactured by Greentrol, Kurz Instruments, or Sierra Instruments shall be submitted for review as a comparable product.
b. Fan Airflow Measurement Devices with Temperature and Airflow Alarming Capability.
c. Airflow measurement devices shall use the principle of thermal dispersion and provide one self-heated bead-in-glass thermistor and one zero power bead-in-glass thermistor at each sensing node.
d. General:
    1) Provide one AMD for each measurement location provided on the plans, schedules and/or control diagrams to determine the average airflow rate and temperature at each measurement location.
    2) Each AMD shall be provided with a microprocessor-based transmitter and one or more sensor probes.
        a) Devices that have electronic signal processing components on or in the sensor probe are not acceptable
    3) Airflow measurement shall be field configurable to determine the average actual or standard mass airflow rate.
        a) Actual airflow rate calculations shall have the capability of being corrected by the transmitter for altitudes other than sea level.
    4) Temperature measurement shall be field configurable with velocity weighted average as the default, or manual selection of arithmetic average temperature.
e. Sensor Probes:
    1) Sensor probes shall consist of one sensor node mounted on a 304 stainless steel block with two adjustable zinc plated steel rods connected to 304 stainless steel pivoting mounting feet.
    2) Sensor node internal wiring connections shall be sealed and protected from the elements and suitable for direct exposure to water.
    3) Each sensor probe shall be provided with an integral, FEP jacket, plenum rated CMP/CL2P, UL/cUL Listed cable rated for exposures from -67°F to 392 °F and continuous and direct UV exposure.
        a) Plenum rated PVC jacket cables are not acceptable.
    4) Sensor node airflow and temperature calibration data shall be stored in a serial memory chip in the cable connecting plug and not require matching or adjustments to the transmitter in the field.
    5) Each sensor node shall be provided with two bead-in-glass, hermetically sealed thermistors potted in a marine grade waterproof epoxy with sensor housings constructed of glass-filled polypropylene.
    6) Each thermistor shall be individually calibrated at a minimum of 3 temperatures to NIST-traceable temperature standards.
    7) Each sensor node shall be individually calibrated at 16 measurement points to airflow standards directly calibrated at NIST to the NIST Laser Doppler Anemometer (LDA) primary velocity standard and have an accuracy of ±2% of reading over the entire calibrated airflow range of 0 to 10,000 FPM.
        a) Devices calibrated against standards other than the NIST LDA or against NIST temperature standards only are not acceptable.
    8) Each sensor node shall have a temperature accuracy of ±0.15° F over an operating range of -20° F to 160° F and humidity range of 0 to 100% RH.

9) The number of independent sensor nodes provided shall be as follows:
   a) SWSI and DWDI fans: 2 probes x 1 sensor node/per probe in each fan inlet.
   b) Fan Arrays (1 to 8 fans): 1 probe x 1 sensor node probe in each fan inlet

f. Transmitter:
   1) A remotely located microprocessor-based transmitter shall be provided for each measurement location.
   2) The transmitter shall be comprised of a main circuit board and interchangeable interface card.
   3) The transmitter shall be capable of determining the airflow rate and temperature of each fan.
      a) Separate integration buffers shall be provided for display airflow output, airflow signal output (analog and network) and individual sensor output (IR-interface).
   4) The transmitter shall have startup firmware to facilitate setup of multiple fans and fan areas.
   5) The transmitter shall be capable of providing a low and/or high airflow set point alarm.
   6) The transmitter shall be capable of providing individual fan alarming on fan array configurations.
   7) The transmitter shall be capable of identifying a malfunction via the system status alarm and ignore any sensor node that is in a fault condition.
   8) The transmitter shall be capable of field configuration, diagnostics and include Field Output Adjustment Wizard that allows for a one or two point field adjustment to factory calibration for installations that require adjustment.
   9) The transmitter shall be provided with a 16-character, alpha-numeric, LCD display.
   10) The transmitter shall be provided with two field selectable (0-5/0-10 VDC or 4-20mA), scalable, isolated and over-current protected analog output signals (AO1=airflow, AO2=temperature or alarm), in combination with
      a) one isolated Ethernet (simultaneously supported BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) network connection.
   11) Analog signal capability shall include two output terminals: the first (AO1), shall provide the total airflow rate; while the second output (AO2) shall be field configurable to provide one of the following:
      a) temperature
      b) low and/or high airflow user-defined set point alarm
      c) individual fan alarm; or
      d) system status alarm
   12) Network communications RS 485 (BACnet MS/TP or Modbus RTU) or Ethernet (BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) shall provide: the average airflow rate, temperature, hi and/or low airflow set point alarm, system status alarm, individual sensor node airflow rates and individual sensor node temperatures.
   13) The transmitter shall use a “watchdog” timer circuit to ensure automatic reset after power disruption, transients and brown-outs.
   14) Each transmitter shall have an operating range of -20° F to 120° F and humidity range of 5 to 95% RH.

g. Listings and Certifications
   1) The Air Measurement Station shall be UL/cUL 873 Listed as an assembly.
      a) Devices claiming compliance with the UL Listing based on individual UL component listing are not acceptable.

2) All network-capable AMD models supplied with RS-485 interface and BACnet protocol shall be BTL Listed.

h. Installation
1) Install in accordance with manufacturer's placement and installation guidelines

2. Duct Mounted Air Flow Measuring Stations:

a. Basis of design shall be EBTRON Model GTX116-P+. Comparable product as manufactured by Greentrol, Kurz Instruments, or Sierra Instruments shall be submitted for review as a comparable product.
b. Airflow Measurement Devices with Temperature Output and Airflow Alarming Capability.
c. Airflow measurement devices shall use the principle of thermal dispersion and provide one self-heated bead-in-glass thermistor and one zero power bead-in-glass thermistor at each sensing node.
d. General:
1) Provide one AMD for each measurement location provided on the plans, schedules and/or control diagrams to determine the average airflow rate and temperature at each measurement location.
2) Each AMD shall be provided with a microprocessor-based transmitter and one or more sensor probes.
a) Devices that have electronic signal processing components on or in the sensor probe are not acceptable.
3) Airflow measurement shall be field configurable to determine the average actual or standard mass airflow rate.
a) Actual airflow rate calculations shall have the capability of being corrected by the transmitter for altitudes other than sea level.
4) Temperature measurement shall be field configurable with velocity weighted average as the default, or manual selection of arithmetic average temperature.
e. Sensor Probes:
1) Sensor probes shall be constructed of gold anodized, 6063 aluminum alloy tube.
2) Sensor probe mounting brackets shall be constructed of 304 stainless steel.
3) Probe internal wiring between the connecting cable and sensor nodes shall be Kynar coated copper.
a) PVC jacketed internal wiring is not acceptable.
4) Probe internal wiring connections shall consist of solder joints and spot welds.
a) Internal wiring connections shall be sealed and protected from the elements. They shall be capable of direct exposure to water without affecting instrument operation.
b) Connectors of any type within the probe are not acceptable.
c) Printed circuit boards within the probe are not acceptable.
5) Each sensor probe shall be provided with an integral, FEP jacket, plenum rated CMP/CL2P, UL/cUL Listed cable rated for exposures from -67° F to 392° F and continuous and direct UV exposure.
a) Plenum rated PVC jacket cables are not acceptable.
6) Each sensor probe shall contain one or more independently wired sensing nodes.
7) Sensor node airflow and temperature calibration data shall be stored in a serial memory chip in the cable connecting plug and not require matching or adjustments to the transmitter in the field.

8) Each sensor node shall be provided with two bead-in-glass, hermetically sealed thermistors potted in a marine grade waterproof epoxy with sensor housings constructed of glass-filled polypropylene.
9) Each thermistor shall be individually calibrated at a minimum of 3 temperatures to NIST-traceable temperature standards.
10) Each sensor node shall be individually calibrated at 16 measurement points to airflow standards directly calibrated to the NIST Laser Doppler Anemometer (LDA) primary velocity standard and have an accuracy of ±2% of reading over the entire calibrated airflow range of 0 to 5,000 FPM.
    a) Devices claiming NIST traceability to third party laboratories and not directly to NIST are not acceptable
    b) Devices calibrated against standards other than the NIST LDA are not acceptable.
11) The installed airflow accuracy shall be:
    a) Ducts - ±3% of reading when installed in accordance with the manufactures recommended placement guidelines.
    b) Non-ducted Outdoor Air intakes – better than or equal to ±5% of reading when installed in accordance with the manufactures recommended placement guidelines.
12) Each sensing node shall have a temperature accuracy of ±0.15° F over an operating range of -20° F to 160° F and humidity range of 0 to 100% RH.
13) The number of independent sensor nodes provided shall be as follows:

Area ft^2	# Sensor Nodes
≤ 0.5	1
> 0.5 & ≤ 1	2
> 1 & ≤ 2	4
> 2 & ≤ 4	6
> 4 & ≤ 8	8
> 8 & ≤ 12	12
> 12 & ≤ 14	14
> 14	16

    a) A total of 4 probes shall be required for openings with an aspect ratio ≤ 1.5 and with an area ≥ 25 ft2.

f. Transmitter:
1) A remotely located microprocessor-based transmitter shall be provided for each measurement location.
2) The transmitter shall be comprised of a main circuit board and interchangeable interface card.
3) The transmitter shall be capable of determining the airflow rate and temperature average of all connected sensor nodes in an array for a single location.

a) Separate integration buffers shall be provided for display airflow output, airflow signal output (analog and network) and individual sensor output (IR-interface).

4) The transmitter shall be capable of providing a high and/or low airflow alarm with user-defined set point and % of set point tolerance. Alarm shall be capable of being manually or automatically reset and low-limit cutoff value may be selected to disable the alarm. An alarm delay function shall also be field defined.

5) The transmitter shall be capable of identifying a malfunction via the system status alarm and ignore any sensor node that is in a fault condition.

6) The transmitter shall be capable of field configuration, diagnostics and include Field Output Adjustment Wizard that allows for a one or two point field adjustment to factory calibration for installations that require adjustment.

7) The transmitter shall be provided with a 16-character, alpha-numeric, LCD display.

8) The transmitter shall be provided with two field selectable (0-5/0-10 VDC or 4-20mA), scalable, isolated and over-current protected analog output signals (AO1=airflow, AO2=temperature or alarm), in combination with
   a) one isolated Ethernet (simultaneously supported BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) network connection.

9) The analog signal capability shall include two output terminals: the first (AO1), shall provide the total airflow rate and the second output (AO2) shall be field configurable to provide one of the following:
   a) temperature
   b) low and/or high airflow user-defined set point alarm, or
   c) system status alarm

10) The network communications RS-485 (BACnet MS/TP or Modbus RTU) or Ethernet (BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) shall provide: the average airflow rate, temperature, hi and/or low airflow set point alarm, system status alarm, individual sensor node airflow rates and individual sensor node temperatures.

11) The transmitter shall use a “watchdog” timer circuit to ensure automatic reset after power disruption, transients and brown-outs.

12) Each transmitter shall have an operating temperature range of -20° F to 120° F and humidity range of 5 to 95% RH.

g. Listings and Certifications:
   1) The Airflow Measurement Station shall be UL/cUL 873 Listed as an assembly.
      a) Devices claiming compliance with the UL Listing based on individual UL component listing are not acceptable.
   2) All network-capable AMD models supplied with RS-485 interface and BACnet protocol shall be BTL Listed.

h. Installation:
   1) Install in accordance with manufacturer’s placement guidelines.

3. Static Pressure Traverse Probe:

   a. Duct static traverse probes shall be provided where required to monitor duct static pressure. The probe shall contain multiple static pressure sensors located along exterior surface of the cylindrical probe.
   b. Acceptable manufacturers: Cleveland Controls, Air Monitor.

4. Shielded Static air Probe:

a. A shielded static pressure probe shall be provided at each end of the building. The probe shall have multiple sensing ports, an impulse suppression chamber, and airflow shielding. A suitable probe for indoor and outdoor locations shall be provided.

H. Power Monitoring Devices:

1. Current Measurement (Amps):

a. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Facility Management System.
b. Current Transformer – A split core current transformer shall be provided to monitor motor amps.
   1) Operating frequency – 50 - 400 Hz.
   2) Insulation – 0.6 Kv class 10Kv BIL.
   3) UL recognized.
   4) Five amp secondary.
   5) Select current ration as appropriate for application.
   6) Acceptable manufacturers: Veris Industries
c. Current Transducer – A current to voltage or current to mA transducer shall be provided. The current transducer shall include:
   1) 6X input over amp rating for AC inrushes of up to 120 amps.
   2) Manufactured to UL 1244.
   3) Accuracy: +.5%, Ripple +1%.
   4) Minimum load resistance 30kOhm.
   5) Input 0-20 Amps.
   6) Output 4-20 mA.
   7) Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%).
   8) Acceptable manufacturers: Veris Industries

I. Refrigerant Leak Detectors :

1. Basis of design is MSA model MVR-300 VRF Refrigerant Leak Detector
2. Provide refrigerant detector indicated on the drawings.
3. Refrigerant gas is R-410A
4. NEMA 1 enclosure
5. Low alarm: 2000 PPM
6. High alarm: 4000 PPM
7. Range: 10,000 PPM
8. UL approved
9. Complies with ANSI/ASHRAE 15
10. Small discrete packaging for ceiling or wall mount installations
11. Signal output: BACNET
12. 2 SPDT relay to indicate fault or alarm at BAS station
13. Internal LED to indicate fault or alarm
14. Power requirements: 120V, 4W
15. Mounting height” 12” above finished floor.

J. Smoke Detectors :

1. Duct detectors shall be furnished as specified elsewhere in Division 28 for installation under Division 23 All wiring for air duct detectors shall be provided under Division 28 Fire Alarm System.

K. Status and Safety Switches:

1. General Requirements

   a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BAS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

2. Current Sensing Switches

   a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
   b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
   c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
   d. Acceptable manufacturers: Veris Industries

3. Air Filter Status Switches

   a. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
   b. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
   c. Provide appropriate scale range and differential adjustment for intended service.
   d. Acceptable manufacturers: Johnson Controls, Cleveland Controls, Siemens

4. Air Flow Switches

   a. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
   b. Acceptable manufacturers: Johnson Controls, Cleveland Controls, Siemens

5. Air Pressure Safety Switches

   a. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
   b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
   c. Acceptable manufacturers: Johnson Controls, Cleveland Controls, Siemens

6. Low Temperature Limit Switches

   a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
   b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.

c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.
d. The low temperature limit switch shall be equal to Johnson Controls A70.

2.13 OUTPUT DEVICES

A. Actuators:

1. General Requirements:

a. Damper and valve actuators shall be electronic and/or pneumatic, as specified in the System Description section.
b. Heater:
1) Shall include a self-regulating temperature control to prevent condensation build-up.
2) Shall be pre-wired to the terminal block for ease of connection to external source.
3) Rated output shall be 5 W at 120 or 220 VAC.

2. Electronic Damper Actuators:

a. Electronic damper actuators shall be direct shaft mount.
b. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized Based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.
c. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.
d. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.
e. Acceptable manufacturers: Johnson Controls, Belimo, or Siemens.

3. Electronic Valve Actuators:

a. Electronic valve actuators shall be manufactured by the valve manufacturer.
b. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.

c. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized Based on valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.

d. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

e. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller.

f. Acceptable manufacturers: Johnson Controls, Belimo, or Siemens

B. Control Dampers:

1. The BAS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BAS Contractor or as specifically indicated on the Drawings.
2. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.
3. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.
4. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 60". Damper blades shall be 16-gauge minimum and shall not exceed eight (8) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48"x48" size shall not leak in excess of 8.0 cfm per square foot when closed against 4" w.g. static pressure when tested in accordance with AMCA Std. 500.
5. Airfoil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2.5" w.g., but no more than 4000 FPM or 6" w.g. Acceptable manufacturers are Johnson Controls D-7250 D-1250 or D-1300, Ruskin CD50, and Vent Products 5650.
6. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below. Acceptable manufacturers are: Johnson Controls D-1600, Ruskin CD36, and Vent Products 5800.
7. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jackshaft shall receive at least one actuator to reduce jackshaft twist.

8. Provide Ruskin Model SP100 End Switch Package for control dampers or comparable products as manufactured by Johnson Controls or Vent Products.

C. Control Relays:

1. Control Pilot Relays

a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
b. Mounting Bases shall be snap-mount.
c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
d. Contacts shall be rated for 10 amps at 120VAC.
e. Relays shall have an integral indicator light and check button.
f. Acceptable manufacturers: Johnson Controls, Lectro

2. Lighting Control Relays

a. Lighting control relays shall be latching with integral status contacts.
b. Contacts shall be rated for 20 amps at 277 VAC.
c. The coil shall be a split low-voltage coil that moves the line voltage contact armature to the ON or OFF latched position.
d. Lighting control relays shall be controlled by:
   1) Pulsed Tri-state Output – Preferred method.
   2) Pulsed Paired Binary Outputs.
   3) A Binary Input to the Facility Management System shall monitor integral status contacts on the lighting control relay. Relay status contacts shall be of the “dry-contact” type.
e. The relay shall be designed so that power outages do not result in a change-of-state, and so that multiple same state commands will simply maintain the commanded state. Example: Multiple OFF command pulses shall simply keep the contacts in the OFF position.

D. Electronic Signal Isolation Transducers:

1. A signal isolation transducer shall be provided whenever an analog output signal from the BAS is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input signal from a remote system.
2. The signal isolation transducer shall provide ground plane isolation between systems.
3. Signals shall provide optical isolation between systems.
4. Acceptable manufacturers: Advanced Control Technologies

E. External Manual Override Stations:

1. External manual override stations shall provide the following:

a. An integral HAND/OFF/AUTO switch shall override the controlled device pilot relay.
b. A status input to the Facility Management System shall indicate whenever the switch is not in the automatic position.
c. A Status LED shall illuminate whenever the output is ON.
d. An Override LED shall illuminate whenever the HOA switch is in either the HAND or OFF position.
e. Contacts shall be rated for a minimum of 1 amp at 24 VAC.

F. Electronic/Pneumatic Transducers:

1. Electronic to Pneumatic transducers shall provide:

    a. Output: 3-15 PSIG.
    b. Input: 4-20 mA or 0-10 VDC.
    c. Manual output adjustment.
    d. Pressure gauge.
    e. External replaceable supply air filter.
    f. Acceptable manufacturers: Johnson Controls, Mamac

2.14 MISCELLANEOUS DEVICES

A. Local Control Panels:

1. All control panels shall be factory constructed, incorporating the BAS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.
2. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
3. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.
4. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
5. All wiring shall be neatly installed in plastic trays or tie-wrapped.
6. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

B. Power Supplies:

1. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
2. Input: 120 VAC +10%, 60Hz.
3. Output: 24 VDC.
4. Line Regulation: +0.05% for 10% line change.
5. Load Regulation: +0.05% for 50% load change.
6. Ripple and Noise: 1 mV rms, 5 mV peak to peak.
7. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
8. A power disconnect switch shall be provided next to the power supply.

C. Thermostats:

1. Electric room thermostats of the heavy-duty type shall be provided for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

2.15 UNIVERSAL THERMOSTAT GUARDS

A. Provide size to match thermostat

B. Guards shall be constructed of smoke-colored transparent polycarbonate.

C. Provide tamper-resistant lock; key can be removed only when in the locked position.

D. Shall be suitable for vertical or horizontal mount.

E. Guard base vents shall allow airflow for optimum thermostat performance.

F. Basis of design shall be Honeywell Versaguard™ or comparable acceptable product.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section: “Execution and Closeout Requirements:” Requirements for installation examination.

B. Division 01 Section: “Administrative Requirements”: Coordination and project conditions.

C. Verify building systems to be controlled are ready to operate.

D. Verify that air handling units and ductwork have been accepted and air filters are in place before installing sensors in air streams.

E. Verify location of thermostats**,** humidistats, and other exposed control sensors with Drawings before installation.

F. Verify conditioned power supply is available to control units and to operator workstation.

G. Verify field end devices and wiring are installed prior to installation proceeding.

3.2 INSTALLATION

A. BAS Specific Requirements:

1. Graphic Displays :

    a. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.
    b. User shall access the various system schematics via a graphical penetration scheme and/or menu selection. .

2. Custom Reports:

    a. Provide custom reports as required for this project:

3. Sequence of Operation:

    a. The sequence of operation text shall be easily accessed from the appropriate graphic screen.

B. BAS Wiring:

1. All conduit, wiring, accessories and wiring (low and power line voltage) connections required for the installation of the Building Management System, as herein specified, shall be provided by the BAS Contractor unless specifically shown on the Electrical Drawings under Division 26. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.
2. All BAS wiring materials and installation methods shall comply with BAS manufacturer recommendations.
3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BAS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BAS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
4. Class 2 Wiring:

    a. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
    b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5’ from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

C. BAS Line Voltage Power Source:

1. 120-volt AC circuits used for the Building Management System shall be taken from circuit breakers designated as spare in nearby electrical panels. Refer to electrical drawings and specs.
2. Circuits used for the BAS shall be dedicated to the BAS and shall not be used for any other purposes.
3. DDC terminal unit controllers may use AC power from motor power circuits.

D. BAS Raceway:

1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2”.
2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used only as pre-approved by the Architect. Submit request for approval in writing, via a request for information.
3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.

4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.
5. Penetrations

    a. Provide fire stopping for all penetrations used by dedicated BAS conduits and raceways.
    b. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
    c. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
    d. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

E. BAS Identification Standards:

1. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.
2. Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

F. BAS Panel Installation:

1. The BAS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
2. The BAS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

G. Input Devices:

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BAS in accessible local control panels wherever possible.

H. HVAC Input Devices – General:

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BAS in accessible local control panels wherever possible.
3. The mechanical contractor shall install all in-line devices such as pressure taps, airflow stations, etc.
4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
5. Outside Air Sensors:

    a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.
    b. Sensors shall be installed with a rain proof, perforated cover.
6. Building Differential Air Pressure Applications (-1" to +1" w.c.):

    a. Transmitters' exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
    b. The interior tip shall be inconspicuous and located as shown on the drawings.

7. Air Flow Measuring Stations:

    a. Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct.
    b. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.
8. Duct Temperature Sensors:

    a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
    b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
    c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
    d. The sensor shall be mounted to suitable supports using factory approved element holders.
9. Space Sensors:

    a. Shall be mounted per ADA requirements.
    b. Provide lockable tamper-proof covers where indicated on the plans or elsewhere in this Section.
10. Air Differential Pressure Status Switches:

    a. Install with static pressure tips, tubing, fittings, and air filter.
11. HVAC Output Devices:

    a. All output devices shall be installed per the manufacturer's recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
    b. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.
        1) All actuator openings including conduit are to be properly sealed to prevent air movement and condensate buildup.
    c. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
    d. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems.

I. UPS DEVICES

1. Connect all UPS devices to emergency power circuits.
2. Connect low battery alarm to BAS alarm points.

J. Controls Contractor Shall Install Wiring, Controls Shall Be Furnished By Equipment Manufacturers Such As Thermostats For Split Systems

3.3 TAB COORDINATION AND SOFTWARE

A. Provide the Testing and Balancing Agency all control system software that would provide their capability to calibrate the following devices through the BAS system:

1. Terminal equipment controllers, VRF controllers, etc.
2. Air flow measuring stations and devices.

3.4 FIELD QUALITY CONTROL

A. Division 01 Section: “Quality Requirements”: Requirements for inspecting and testing.

B. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including wiring and electrical connections. Report results in writing.

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
3. Calibrate Test controllers by disconnecting input sensors and stimulating operation with compatible signal generator.

C. Engage a factory-authorized service representative to perform startup services.

D. Replace damaged or malfunctioning controls and equipment.

1. Start, test, and adjust control systems.
2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

E. Place Building Management System (BAS) in the required modes of operation as requested by the Testing and Balancing Contractor (TAB). Provide programming changes and reporting of data from the BAS needed to achieve proper performance.

F. Re-check fan static pressure control setpoints to ensure that the static pressure set points are the lowest value which enables terminal units to deliver design maximum flow plus or minus 10 percent with the variable frequency controller at maximum speed. The TAB Contractor shall make any fan adjustments needed. Adjust setpoint as requested by the TAB Contractor.

G. Verify DDC as follows:

1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
2. Verify operation of operator workstation.
3. Verify local control units including self-diagnostics.
4. Coordinate with commissioning agent.

3.5 DEMONSTRATION AND TRAINING

A. Division 01 Section: “Execution and Closeout Requirements”: Requirements for demonstration and training.

B. Demonstrate complete operation of systems, including sequence of operation prior to Date of Substantial Completion.

C. Demonstrate complete and operating system to Owner.

D. The BAS contractor shall provide the following minimum basic training services:

1. Three days of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BAS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

3.6 MAINTENANCE

A. Division 01 Section: “Execution and Closeout Requirements: Requirements for maintenance service.

B. Provide service and maintenance of control system for one year from date of Substantial Completion.

C. Furnish complete service of controls systems, including callbacks.

D. Inspections:

1. Perform minimum of eight complete normal inspections of approximately four hours' duration in addition to normal service calls to inspect, calibrate, and adjust controls.
2. Furnish four complete subsequent inspections per year, one in each season, to inspect, calibrate, and adjust controls.
3. Submit written report after each inspection.

E. Examine unit components monthly and clean, adjust, and lubricate equipment.

F. Provide systematic examination, adjustment, and lubrication of unit and controls checkout and adjustments.

G. Repair or replace parts according to manufacturer's operating and maintenance data, using parts produced by manufacturer of original equipment.

H. Perform Work without removing units from service during normal building occupied hours.

I. Provide emergency callback service at all hours for this maintenance period.

J. Replacement Parts:

1. Maintain adequate stock of parts locally for replacement or emergency purposes.
2. Ensure personnel availability to fulfill parts service without unreasonable loss of time.

K. Perform Work using personnel under supervision of manufacturer or original installer.

L. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

3.7 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section “Commissioning”.

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable

C. Fully commission all aspects of the Building Management System work.

D. Support all commissioning activities and testing as outlined in the Commissioning Plan.

1. Refer to detailed roles and responsibilities of Controls Contractor in the Commissioning Plan.
2. Attend all commissioning meetings as outlined in the Commissioning Plan.
3. The technician who programmed the job shall be present on site to work with the Commissioning Agent for all functional performance testing.
4. Promptly rectify all controls related issues recorded in the Commissioning Issues Log and submit to the Owner, Commissioning Agent (CxA) and Engineer when each item is corrected. (Note: The CxA does not provide any directives, so any deviation from the original scope must be approved by the Owner or Engineer prior to performing work.

3.8 ADDITIONAL PROGRAMMING

A. Provide additional 40 hours of programming and re-programming to adjust and alter control sequences to be performed after the original sequence of operation is programmed and operational. Time shall be accounted for by hourly work tickets with copies of work tickets provided to the Architect.

3.9 ON-SITE ASSISTANCE

A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by Owner, to adjust and calibrate components and to assist Owner’s personnel in adjusting sensors, settings, and controls, etc... to suit actual conditions.

B. Return to site in season to demonstrate (and instruct operating personnel) so that both heating and cooling season operation is demonstrated.

3.10 SEQUENCES OF OPERATION

Refer to Sequence of Operation on Drawings.

3.11 POINTS LIST

Refer to Sequence of Operation on Drawings.

END OF SECTION

SECTION 23 12 13
FACILITY FUEL-OIL PUMPS

GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specifications, apply to this section, and the other sections of Division 23.

1.2 SUMMARY

A. Section includes:

1. Fuel oil pumps.
2. Transfer system.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 03 Section: “Cast-In-Place Concrete”: Product requirements for concrete ballast and fill pads for pump inertia bases for placement by this section.
2. Division 23 Section: “Common Work Results for Plumbing.”
3. Division 23 Section: “Common Motor Requirements:” Product requirements for electric motors for placement by this section.
4. Division 23 Section: “Hangers and Supports for HVAC Piping and Equipment”: Product requirements for hangers for placement by this section.
5. Division 23 Section: “Vibration and Seismic Controls for HVAC Piping and Equipment”: Product requirements for vibration isolators for placement by this section.
6. Division 23 Section: “Pipes and Tubes for Plumbing Piping and Equipment:” Product requirements for fuel oil piping connected to oil-fired heaters.
7. Division 26 Section: “Low Voltage Electrical Power Conductors and Cables:” Requirements for electrical wiring and cable connections for units specified in this section.
8. Division 26 Section: “Raceways and Boxes for Electrical Systems:” Requirements of conduits and boxes housing electrical wiring and connections specified by this section.

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”)

A. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. National Fire Protection Association:

1. NFPA 30 - Flammable and Combustible Liquids Code.

2. NFPA 31 - Standard for the Installation of Oil-Burning Equipment.

C. Underwriters Laboratories Inc.:

1. UL 343 - Pumps for Oil-Burning Appliances.

1.4 SUBMITTALS

A. Division 01 Section – “Submittal Procedures”: Submittal Procedures.

B. Product Data:

1. Pumps: Submit published pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.

C. Manufacturer's Installation Instructions: Submit data for each type of pump.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

E. Manufacturer's Field Reports: Submit report of each visit of manufacturer’s representative to provide technical assistance during installation.

F. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.5 CLOSEOUT SUBMITTALS

A. Division 01 Section – “Execution and Closeout Requirements”: Closeout procedures.

B. Project Record Documents: Record actual locations of pumps.

C. Operation and Maintenance Data: Submit spare parts lists for pumps.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with NFPA 30 and NFPA 31.

B. List and label pumps in accordance with UL 343.

C. Perform Work in accordance with all applicable codes, standards and local authorities having jurisdiction requirements.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.8 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section – “Product Requirements”: Product storage and handling requirements.

B. Accept pumps on site in shipping containers with labeling in place. Inspect for damage.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

A. Division 01 Section – “Execution and Closeout Requirements”: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for pumps.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE PUMP (SP-1)

A. General
1. ⅓ and ¾ Hp fixed speed models are available in variable length and fixed length options.
2. Check valve: 2¾" diameter fluorocarbon seal constructed with cast aluminum body and steel backing washer.
3. Pressure relief valve: available in four pressure relief settings, integral to check valve. Standard model relieves at 40 psi and resets above 35 psi.
4. Syphon: venturi-type syphon primer supplied with every submersible. Syphon check valve and secondary syphon sold separately.
5. Air eliminator: every submersible includes a tank return path with one-way check valve to provide active air elimination.
6. Electrical disconnect: electrical yoke for positive contractor disconnect during service.

B. Approvals

1. cULus listed.
2. Consult factory for applicable approvals.

C. Pump Motor

1. ⅓ and ¾ Hp fixed speed, 3450 rpm, two-stage centrifugal type pump motor with integral, automatic thermal overload protection.
2. ⅓ Hp models have a max. pressure of 27 psi.
3. ¾ Hp models have a max. pressure of 30 psi.

D. Power Requirements

1. ⅓ and ¾ hp fixed speed models require single-phase, 208-230 VAC, 60 Hz incoming power.
2. ⅓ and ¾ hp fixed speed models incorporate a starting and running capacitor, with internal bleed resistor, rated 370 Volt, 15 microfarad.
3. STP-SCI single-phase Smart Controllers and STP-CBS single-phase control boxes are available for ⅓ and ¾ hp pump control.
4. ⅓ hp max. motor draw: 4 Amps.
5. ¾ hp max. motor draw: 7 Amps.

E. Liquid Compatibility

1. Max. liquid viscosity: 70 SSU at 60 °F (15 °C).
2. STP variable speed models are UL listed for fuel mixtures containing up to 10% ethanol, and 20% MTBE, 20% ETBE or 17% TAME with gasoline.
3. IST/ISTAP variable speed models are UL and cUL listed for fuel mixtures containing diesel fuel with up to 20% Biodiesel, 100% Biodiesel, up to 85% ethanol with gasoline, and 20% MTBE, 20% ETBE or 17% TAME with gasoline.
4. All variable speed models can also be used with diesel fuels, fuel oils, kerosene, Avgas and jet fuels in a non-gelled pourable state.
5. All wetted elastomers are made of a high grade, fluorocarbon compound.

2.2 FUEL MANAGEMENT SYSTEM (FMS-1)

A. Smart Cards: When used as a proprietary card it has eight (8) discount levels. Smart Cards can be sold as prepaid cards.

B. Interface with FBO Software: FUELMASTER® software provides flat ASCII file for easy interface with FBO management software.

C. Inventory Control/Tank Monitor Interface: The addition of a Tank Monitor Interface kit permits automatic reconciliation of tank levels with FUELMASTER®'s declining balance.

D. Tanker Truck Accountability: Refueling accomplished by tanker trucks may be captured by using a Mobile FUELMASTER® WTF 2600. Designed for the military, this system transmits data up to two miles by radio frequency back to a PC that saves the transactions and provides them to FBO management software.

E. Expandability. The FUELMASTER® system may be expanded to control an almost limitless number of fueling sites. Also, the number of customers and system users is almost limitless.

F. Modular Electronics: Modular design and construction ensures reliability and ease of mainte-nance of your FUELMASTER® Fuel Management System. Site operators can quickly and easily change-out modular components, if necessary, with the assistance of FUELMASTER® technicians.

G. Credit Cards: Activated by both aviation and major credit cards. Up to three-hundred (300) credit cards may be entered with a specific discount for each. Thus, the site operator can provide discounts to frequent customers. Discounts may also be provided to a specific major oil card.

H. Ease of Use: Easy step-by-step instructions to follow.

I. Transactions Capacity: Holds 4000 transactions.

J. Central Controller: The preferred PC is a Pentium III. The modem (internal or external) must be 100% Hayes-compatible. A PC and modem are not included with the base FUELMASTER® system, but may be ordered through Syn-Tech Systems as part of a total package. Please check to determine if an existing PC will adequately support FUELMASTER® software.

K. Warranty: FUELMASTER® is warranted for two years from date of installation or fifteen months from date of shipment.

L. Surge Suppression: The FMU 2550/60 comes with built-in AC and telephone surge protection specifically designed for FUELMASTER®.

M. Customer Satisfaction: Check with FUELMASTER® customers before you buy a fuel management system. You'll find that FUELMASTER®'s rugged construction and ease of maintenance maximizes its benefit to our customers. FUELMASTER® owners, who previously operated other brands of fuel management systems, are our best salespeople.

N. Communication: Internal modems allow for long distance communications with standard voice-grade, analog telephone lines.

O. Operating Temperatures: -60 degrees to +140 degrees F (system includes built-in thermostatically controlled heaters.)

P. Power Requirements: 120 VAC 60 Hz

2.3 GASOLINE DISPENSER (DISP-1)

A. General

1. Provide Gasboy model 9153K high flow with mechanical register gas dispenser system.
2. High-flow rated at 22 gpm
3. 10-vane suction pump with 1 HP motor. Power-operated reset mechanism.
4. Pulser options for interface to site controllers Keytrol option still available

B. Construction

1. Rugged and welded G90 galvanized-steel frame
2. Structural foam bezel with a clear polycarbonate window, and a backscreen polycarbonate dialface
3. Field-wiring junction box for easy installation
4. Replaceable sheathing – painted or optional 304 embossed stainless steel
5. Standard hydraulics – compatible with traditional motor fuels such as Biodiesel (up to B20) and Ethanol (up to E15); custom models are available for E85, B100 or DEF
6. Safety listed and with NTEP CoC for W&M sealing for fuel resale application
7. Optional High Retrievers and Catlow's hanging hardware to complete your fleet fueling equipment

2.4 TANK MONITORING SYSTEM (TMS-1)

A. The TLS-450PLUS Automatic Tank Gauge (ATG) is a powerful tool that allows fueling operations to run at peak efficiency, with an easy to understand navigation, streamlined inventory and compliance reporting, and powerful business analytics. It can monitor up to 64 tanks, or 32 tanks with BIR. Frequent releases of operating software for the TLS-450PLUS tank gauge assures that data is secure and software features are routinely updated and enhanced.

B. General:
1. Operating Temperature +32 to +104°F (0 to +40°C)
2. Storage Temperature -40 to +158°F (-40 to +70°C)
3. Installation Location NEMA 4 or indoors
4. Relative Humidity 0-90% (non-condensing)
5. External Dimensions 18.4" x 11" x 8.8" (46.74cm x 27.94cm x 22.35cm)
6. Construction 16GA (0.060 in/0.1524 cm) powder coated steel
7. Console Power Wiring Requirements AC Power Wiring – Wires carrying 120 or 240 VAC from power panel to the console should be #14 AWG (or larger) wire for line, neutral & chassis ground (3) ; and 4 sq. mm, rated for at least 90C for barrier ground.
8. Probe & Sensor to Console Wiring Requirements
   a. Wire Type – Shielded cable required regardless of conduit material or application. It must be rated less than 100 picofarad per ft manufactured with a suitable material such as Carol C2534 or Belden 88760, 8760, or 8770.
   b. Wire Length – Maximum 1,000ft (304.8m) to meet intrinsic safety requirements. Improper system operation could result for runs over 1,000ft (304.8m).
   c. Wire Gauges – Color coded – shielded cable used in all installations. Wires should be #14 - #18 AWG stranded copper wire and installed as Class 2 circuits. As an alternate method when approved by the local authority having jurisdiction, #22 AWG wire such as 88761 may be suitable with the following requirements: Wire run is less than 750ft (228.6m), Capacitance does not exceed 100 pF/ft; Inductance does not exceed 0.2 uH/ft.
9. System Power Requirements AC Input – Universal AC power supply: 100 to 249 VAC, 50/60Hz, 2A max.
10. Display Specifications 8” (20.32cm) Color WVGA LCD touch screen display

11. Connectivity Methods Ethernet, Web Browser, Modem, Fax, Serial
12. Data Storage Features SD card
13. Software Security Features Centralized Device Management to protect your network of TLS-4XX consoles
14. Custom User Access Front Panel Display control through user specific log-in; User defined roles to restrict access / functionality.
15. Screen permissions can be limited to view, edit, perform
16. System Security
    a. Partitioned Ethernet Ports that can be used to separate user network from the internet
    b. Port availability control: SSH Port (22), HTTPS Port (443), Serial Command Port (10001)
    c. Reassign Port Numbers (i.e., HTTPS on 50443)
    d. System Integrator CVE Scans & Fixes
    e. Periodic System Updates to protect against persistent threats
17. Customized Alarm Features Customizable for all alarms
18. Approvals UL cUL, ATEX, IECEx, NEPSI, FCC, FMC, PESO, ANZEx, ULC, INMETRO, IQC, EAC, NWGLDE, and CEN

PART 3 - EXECUTION

3.1 INSTALLATION - PUMPS

A. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation.

B. Install reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled or base mounted pumps, install supports under elbows on pump suction and discharge line sizes 4 inches (102 mm) and over.

C. Install pumps on vibration isolators.

D. Install flexible connectors at or near pumps as indicated on the contract drawings.

E. Provide line sized shut-off valve and strainer on pump suction, and line sized check valve, balancing valve, and shut-off valve on pump discharge.

F. Install piping accessories and pressure gages furnished loose with pump package.

G. Provide valving and specialties as indicated on the contract drawings.

H. Check, align, and certify alignment of base mounted pumps prior to start-up.

I. Install prefabricated base mounted pumps on 4” high concrete housekeeping pads, with anchor bolts, set and level, dimensions per contract drawings. Refer to division 03: “Cast In Place Concrete”.

J. Lubricate pumps before start-up.

K. Install Work in accordance with all applicable codes, standards and local authorities having jurisdiction requirements.

3.2 FIELD QUALITY CONTROL

A. Division 01 Section – “Quality Requirements”: Field inspection, testing, adjusting, and balancing.

B. Inspect for alignment of base mounted pumps.

3.3 DEMONSTRATION

A. Division 01 Section – “Execution and Closeout Requirements”: Requirements for demonstration and training.

B. Engage a factory authorized service representative to train Owner’s maintenance personnel to adjust, operate and maintain fuel-oil pumps and/or transfer system.

1. Train Owner’s maintenance personnel on procedures and schedules for starting up and shutting down fuel-oil pumps/transfer systems, trouble shooting, servicing and maintaining fuel-oil pumps and transfer systems. Furnish services of manufacturer’s technical representative for one 8 hour day to instruct Owner’s personnel in operation and maintenance of units.
2. Review data in maintenance manuals.
3. Schedule training with owner at least seven (7) days advance notice.

3.4 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section “Commissioning”.

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable

END OF SECTION

SECTION 23 13 00
FACILITY FUEL STORAGE TANKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and 01 Specification Sections, apply to this Section, and the other sections of Division 23.

1.2 SUMMARY

A. Section includes:

1. Aboveground fuel storage tanks.
2. Aboveground steel secondary containment dike tank.
3. Leak detection and location system.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 05 Section: “Metal Fabrications:” Product and execution requirements for bollards for placement by this section.
2. Division 22 Section: “Pipes and Tubes for Plumbing Piping and Equipment” for fuel oil piping, specialties, and accessories inside the building.
3. Division 23 Section: “Facility Fuel Oil Pumps” for above ground fuel pump sets and accessories.
4. Division 26 Section: “Grounding and Bonding for Electrical Systems:” Product and execution requirements for grounding for placement by this section.

1.3 REFERENCES

A. American Petroleum Institute:

1. API 650 - Welded Steel Tanks for Oil Storage.
2. API 2000 - Venting Atmospheric and Low-Pressure Storage Tanks: Nonrefrigerated and Refrigerated.

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. National Fire Protection Association:

1. NFPA 30 - Flammable and Combustible Liquids Code.

D. Underwriters Laboratories Inc.:

1. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids.

2. UL 567 - Pipe Connectors for Flammable Liquids and Combustible Liquids and LP-Gas.
3. UL 913 - Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous Locations.
4. UL 2085 - Standard for Safety for Insulated Aboveground Tanks Flammable and Combustible Liquids.

1.4 DEFINITIONS

A. The following are industry abbreviations for fuel tanks:

1. AST: Aboveground, fuel-oil storage tank(s).

B. The following are industry abbreviations for plastic materials:

1. PE: Polyethylene plastic.
2. PTFE: Polytetrafluoroethylene plastic.
3. RTRP: Reinforced thermosetting-resin pipe.
4. TFE: Tetrafluoroethylene plastic.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

A. Aboveground fuel-oil distribution piping minimum working pressure rating: 150 psig.

B. Double contained piping carrier pipe minimum working pressure rating: 150 psig.

C. Double contained piping secondary containment conduit minimum working pressure rating: 5 psig.

D. Vent, gage, and fill piping minimum working pressure rating: 100 psig.

E. Minimum test pressure rating for inner tank smaller than 12-foot diameter: 5 psig.

F. Minimum test pressure rating for containment shell smaller than 12-foot diameter: 5 psig

G. Minimum test pressure rating for inner tank, 12-foot and larger diameter: 3 psig

H. Minimum test pressure rating for containment shell, 12-foot and larger diameter: 3 psig

1.6 SUBMITTALS

A. Division 01 Section – “Submittal Procedures”: Submittal Procedures.

B. Shop Drawings:

1. Tanks: Indicate for fuel oil tanks dimensions; number, size, and location of openings; number, size, and location of manholes; number and location of hold down straps, and accessories. Indicate dimensions, reinforcing steel size, and reinforcing steel location of pads.

C. Product Data:

1. Tanks: Submit manufacturer's catalog information including capacity.
2. Leak Detection and Location System: Submit manufacturer's catalog information for controller, alarm unit, and cable type.

D. Test Reports: Submit written test results for tank pressure test.

E. Manufacturer's Installation Instructions: Submit tanks, and leak detection and location system data.

F. Manufacturer's Certificate:

1. Certify Products meet or exceed specified requirements.
2. Submit certificate of evaluation of leak detection and location system by independent third party.

G. Manufacturer's Field Reports: Submit report of each visit of manufacturer's representative to provide technical assistance during installation.

H. Maintenance Data: For accessories and specialties to include in maintenance manuals specified in Division 01.

I. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

J. Satisfy the Maryland Department of the Environment (MDE) tank registration requirements. Complete the registration forms in collaboration with the Baltimore County Department of Public Works (DPW).

1.7 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of manholes, tanks, and leak detection and location system.

C. Operation and Maintenance Data: Submit spare parts lists, exploded assembly views for tanks, and leak detection and location system.

1.8 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and capacity requirements of fuel-oil distribution components and are based on specific types and models indicated. Other manufacturers' products with equal performance characteristics may be considered.

B. Distribution Components: Listing/approval stamp, label, or other marking by testing agency acceptable to authorities having jurisdiction.

C. Electrical Devices, Components, and Equipment: Listed and labeled according to NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

D. Comply with ASME B31.1, "Power Piping," for fuel oil piping materials and joining requirements.

E. Comply with NFPA 30, “Flammable and Combustible Liquids Code,” for design and construction, installation, inspection, and testing of fuel-oil distribution system tanks, piping, and other components.

F. Comply with NFPA 70, “National Electrical Code,” for electrical connections between wiring and electrically operated devices.

G. Comply with NFPA 780, “Lightning Protection Systems” standard for the installation of lightning protection systems.

H. Comply with requirements of the EPA and state and local environmental-protection authorities having jurisdiction. Include recording of fuel-oil storage tanks and monitoring of tanks and piping.

I. Evaluate leak detection and location system by independent third party according to Third Party Procedures developed according to US EPS's "Standard Test Procedure for Evaluating Leak Detection Methods: Liquid-Phase Out-of-Tank Product Detectors." Evaluation results to verify system manufacturer's claim regarding sensitivity, range and other performance data.

J. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, “Welding and Brazing Qualifications.”

1. Comply with ASME B31 Series, “Code for Pressure Piping.”
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Above Ground Fuel Storage Tanks: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

C. Leak Detection Systems: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

D. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.10 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section – “Product Requirements”: Product storage and handling requirements.

B. Lift and support fuel-oil storage tanks only at designated lifting or supporting points, as shown on Shop Drawings. Do not move or lift tanks unless empty.

C. Preparation for Transport: Prepare storage tanks, accessories, valves, and specialties for shipping as follows:

1. Ensure that units are dry and internally protected against rust and corrosion.
2. Protect against damage to threaded ends, flange faces, and weld ends.
3. Set valves and specialties in position for handling that avoids damage to seats and operating parts.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent damage and entrance of dirt, debris, and moisture.

E. Store valves an specialties with end protectors in place, unless necessary for inspection; then reinstall for storage.

F. Store valves and specialties indoors and maintain temperature higher than ambient dew-point temperature. Support off ground or pavement in watertight enclosures if outdoor storage is necessary.

G. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor if stored inside.

H. Protect flanges, fittings, and piping specialties from moisture and dirt.

I. Store plastic pipes protected from direct sunlight. Support pipes to prevent sagging and bending.

1.12 PROJECT CONDITIONS

A. Perform site survey, research utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer’s written permission.

C. Do not install tank foundations when bedding is wet or frozen.

1.13 COORDINATION

A. Division 01 Section – “Administrative Requirements”: Requirements for coordination.

B. Coordinate pipe materials, sizes, entry locations, and pressure requirements with building fuel oil piping systems.

C. Coordinate installation and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Work Interruptions: Leave fuel-oil distribution piping in safe condition if interruptions in Work occur while alterations or repairs are being made to existing fuel oil piping.

1.14 WARRANTY

A. Division 01 Section – “Execution and Closeout Requirements”: Product warranties and product bonds.

B. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

C. Special Warranty: Written warranty, executed by fuel-oil storage tank manufacturer agreeing to repair or replace tanks that fail in materials or workmanship within specified warranty period, provided tanks are installed according to manufacturer’s written instructions. Failures include structural failures of tanks, including cracking, breakup, and collapse; and failure due to external and internal corrosion if used for storage of fuel oils at temperatures not exceeding 150°F (66°C).

D. Furnish 30 year manufacturer warranty for tanks.

E. Furnish 5 year manufacturer warranty for leak detection and location system.

PART 2 - PRODUCTS

2.1 ABOVE GROUND FUEL OIL STORAGE TANK

A. Tank shall be manufactured, tested and labeled in conformance with Underwriters Laboratories’ UL-2085 Standard for Protected Aboveground Tanks for Flammable and Combustible Liquids, Double-wall Construction. Tank shall be manufactured and labeled in strict accordance with Steel Tank Institute (STI) Fireguard® Thermally Insulated, Double-wall Steel Aboveground Storage Tank standards as applied by a licensee of the STI. Tank shall be subject to the STI’s Quality Assurance program and shall be backed by the STI 30-year limited warranty.

B. The tank shall be a rectangular, horizontal, steel tank intended for the storage of flammable and combustible liquids at atmospheric pressure. Tank shall include integral steel secondary containment and thermal insulation that provides a minimum two-hour fire rating. The tank design shall comply with UL 2085 "Protected" Tank standard having been tested for Ballistics, Impact, Hose Stream, and Pool Fire performance standards.

C. Inner (primary) and outer (secondary) tanks shall be fabricated from mild carbon steel with flat-flanged heads, and lap-welds at all seams and joints. Primary and secondary tanks are air tested at the factory. (Primary tank may need to be retested for tightness at the jobsite prior to commissioning. Consult AHJ for requirements.) Tank shall be supplied with emergency vents for the primary and the secondary containment tanks. Emergency venting by "form of construction" is not equal and will NOT be permitted.

D. Tank shall comply with the latest edition of National Fire Protection Association NFPA 30 Flammable and Combustible Liquids Code. The tank system shall also meet or exceed the requirements of:

a. National Fire Protection Association NFPA 30A Automobile And Marine Service Station Code
b. 1997 Uniform Fire Code (UFC) "Protected" AST criteria as per Appendix II-F, including ballistics protection
c. California Air Resources Board (CARB) testing requirements for air emissions
d. International Fire Code

E. Construction

1. Tank shall be of double-wall construction and provide complete secondary containment of the primary storage tank's contents by an impervious steel outer wall. Inner and outer tanks shall be manufactured in accordance with UL-142 Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids as referenced in UL-2085. Tank shall be fabricated of mild carbon steel with shell seams of continuous lap weld construction.

2. A minimum of 3" of porous, lightweight monolithic thermal insulation material shall be installed at the factory within the interstitial space between the inner and outer wall. Thermal insulating material:
   a. Shall be in accordance with American Society of Testing Materials (ASTM) Standards C-332 and C-495.
   b. Shall allow liquid to migrate through it to the monitoring point.
   c. Shall not be exposed to weathering and shall be protected by the steel secondary containment outer wall (an exterior concrete wall or vault exposed to the elements will NOT be permitted).

3. Each tank shall be delivered as a complete UL-listed assembly including the following fittings and components: (All fittings NPT or flanged, shall be supplied with plastic protectors for shipment)

4. Standard tanks shall include, at a minimum, fittings for normal vent, interstitial monitoring, emergency vent for primary tank, emergency vent for secondary tank, product fill, product pump/supply and liquid level gauge. See standard drawings at www.highlandtank.com for quantity, size and location of fittings on standard tanks. All fittings must be located above the maximum fluid level per UL-2085 / STI Fireguard requirements. Normal vent sizes are equal to, or larger than largest fitting to be used for fill or withdraw from the tank. Emergency vent size is based on the wetted surface area of the tank.

5. Two (2) Welded-on Saddles - Design, size and location determined per STI specifications.

6. Lifting lugs shall be provided at balancing points to facilitate handling and installation.

7. Exterior Protective Coating:
   a. Surface Preparation: Grit blast - SSPC-SP-6 White Blast
   b. Finish: White urethane paint system 5-7 DFT on the shell and heads.

8. Tank shall be supplied with a High-LINK® LevelShield Series P, Level Management System that includes:
   a. One (1) Magnetostrictive probe for continuous monitoring of product and water levels, and product temperature (provides temperature-compensated volume

monitoring).Probe Specs:

1) Probe length: 59″ - Additional probe length required
2) Communication cable 78″ (included) - Additional cable length required
3) RS-485 Communication
4) 2 floats – (1) for product level, (1) for water level
5) Thermocouple for product temperature measurement
6) Measuring accuracy up to +/- 0.02″
7) Resolution +/- .004″
8) 316 Stainless Steel Shaft
9) Polypropylene float material
10) Explosion-proof head
11) ¾" compression fitting
12) ¾" x 2” NPT reducer bushing supplied (minimum 2″ opening required)
13) Compatible with gasoline and diesel (Contact Highland Tank for other chemical/product compatibility)

b. CommBox transmits data from connected sensors/probes to cloud-based High-LINK® software platform.

1) CommBox specs: Note: Maximum of two (2) probes per CommBox.
2) NEMA 4 Enclosure
3) 120VAC with terminals for electrical landing
4) 5A 120VAC breaker
5) Active barrier
6) 12VDC power converter
7) Terminal blocks for probe wire landing
8) 4G cellular technology
9) Two (2) Integrated LED/Horn combinations with dry contacts for audible/visual alarms.

F. Equipment

1. Manway(s) Qty: as shown on drawings
2. Remote fill cabinet as shown on drawing.
3. Internal Ladder(s) per drawing
4. HTLP 1.5” Interstitial Float Switch Sensor for leak detection (Requires HTSC 2″ Pipe Cap)
5. HTF-1 Float Switch Interface Stem Sensor for overfill detection
6. Electronic Alarm Panel. Channel quantity
7. High-LINK FuelShield®, Fuel Management System
8. Additional High-LINK Magnetostrictive probe for LevelShield Inventory System (2 Maximum)

Warranty

1. The tank is warranted by Highland Tank & Mfg. Co. to be free from defects in manufacturing, workmanship and materials. Highland Tank will repair or replace, at its sole discretion F.O.B. factory, within a period of one year after date of shipment, any item of our manufacture. All other items shall be warranted by their respective manufacturers. Liability hereunder is limited, as stated above, and does not include labor, installation costs, indirect or consequential damages of any kind. Tanks must be returned to the factory and if found to be defective upon examination, will be repaired, replaced or credit will be issued at our option.

2. Tank to be manufactured by Highland Tank at one of the following locations: Stoystown, PA; Manheim, PA; Watervliet, NY; Greensboro, NC; Friedens, PA; Clarkston, MI or Mancelona, MI.

2.2 ALTERNATE: CONCRETE ABOVE GROUND FUEL OIL STORAGE TANK

A. Manufacturer:

1. ConVault, Inc.

B. Furnish materials in accordance with Authority Having Jurisdiction requirements.

C. Product Description: Tank rated for multiple hazards and constructed of multiple layers consisting of inner steel tank surrounded by insulation, secondary containment tank, and encased in reinforced concrete. The system will provide a multi-hazard rating including 4 hour fire resistance to meet requirements of UL 2085.

D. The Contractor shall furnish and install a complete above ground fuel system. Coordinate work under this section with all other trades of work, to furnish a complete and working fuel system. The Contractor shall be certified and licensed in the project jurisdiction for being qualified to install fuel storage tank systems as per manufacturer's installation requirements.

E. General:

1. All materials shall be compatible for use with No. 2 commercial fuel oil.
2. The complete fuel system shall be in accordance with NFPA Standards No. 30 and No. 31, EPA, MDE, API and all local regulations. All materials shall be UL listed for use with No. 2 commercial fuel oil.
3. Fuel piping and testing are specified in Performance Testing and Balancing.
4. The fuel oil storage system shall be in accordance with NFPA Standards No. 30 and No. 31 and all local regulations. All materials used shall be UL listed and suitable for use with No. 2 commercial fuel oil. The tank size and arrangement shall be as indicated on the contract drawings.

F. Tank construction:

1. Primary Steel Tank:

   a. Primary tank vessel shall be rectangular in shape and constructed with a minimum 1/4 inch carbon steel and intended for stationary, atmospheric pressure usages as allowed by and compliant with N.F.P.A 30 and Uniform Fire Code. All welds shall be continuous and conform to the American Welding Society Standard for continuous welds and manufactured in accordance with UL listing requirements and UL 142.
   b. Tank shall be pressure tested at the factory at 5 psi for 48 hours.
   c. The primary steel tank shall be pressurized at 5psig during concrete encasement. The outer surface of the primary steel tank shall be covered by a minimum of ¼" thick Styrofoam insulation panels.
2. Secondary Containment:

a. The secondary containment shall be impervious to corrosion including damage or failure due to microbial infestation. Because steel is known to be affected by microbial influenced corrosion, the secondary containment shall consist of a 30 mil thick high density polyethylene membrane enclosing the steel tank and insulating material.

3. Concrete Vault:

   a. The primary steel tank and the secondary containment shall be encased in six inches of monolithic reinforced concrete with a minimum design strength of 4000 psi at 28 days. The concrete design shall include the following for long term durability: air entrainment, water reducing admixture, and steel reinforcement. Concrete encasements with seams will not be approved.
   b. The protected and insulated AST system shall be of concrete exterior and a continuous and visually verifiable monolithic (seamless) pour on top, bottom, ends, and sides and contain no cold joints or heat sinks (heat transfer points). The AST must be shop fabricated and tested in accordance with the UL listings. Designs that use two layers of steel with insulating materials between them will not be approved.

4. No steel or insulating material shall come in contact with the concrete or other corrosive material.
5. All openings shall be from top only.
6. All exposed metal with the exception of stainless steel must be powder coated to inhibit corrosion.
7. The protected and insulated AST system shall have a through tank leak detector tube to allow for physical checkup and monitoring capability between the primary and secondary containment.
8. Fire Resistive Properties:

   a. The system shall be designed and tested to provide a minimum 4 hour fire protection barrier against rapid-rise temperature fires of 2,000^{o}F. The fire resistance of the system shall be tested in accordance with established procedures of a certified testing facility.

9. Spill Containment and Overfill Protection:

   a. Each system shall protect against the hazards of spillage and overfill during filling operations.
   b. Spill containment shall consist of a U.L. listed, seven gallon capacity container integral to the primary vessel and internal to the protective vault.
   c. Overfill protection shall be one or more of the following:
      1) A positive shut-off device which stops the flow of product into the tank at 95% capacity and which is designed to withstand the delivery pressures common to pump-off delivery vehicles.
      2) An audible/ visual alarm located in close proximity to the fill port
      3) A direct product level gauge located in close proximity to the fill port.

10. Exterior Finish:

    a. The protected and insulated AST system shall have a coated and concrete exterior to resist weather and reflect sunlight. Models with steel exteriors will not be approved.

11. Venting:

    a. Normal Vent: Furnish each compartment of primary tank with 2 inch updraft venting device exhausting upward at elevation of at least 12 feet aboveground. Size vent in accordance with NFPA 30.

b. Emergency Vent: Furnish each compartment of primary tank with emergency vent sized in accordance with NFPA 30. Do not use access openings for emergency venting purposes.

12. Anti-siphon valve:

a. Where product piping extends below the top of the vault, the piping shall include an anti-siphon valve.
b. The protected and insulated AST system shall have two bolts for connecting grounding conductors cor lightning protection in accordance with NFPA 780.

G. Accessories:

1. Level Gage: Mechanical float activated level gage capable of indicating approximate fluid level in tank reading in feet and inches.
2. Tank Decals: Furnish warning and tank identification signs located prominently on tank following local fire code requirements.
3. Access Steps: Furnish galvanized access platform with working surface of minimum of 24 inches in width, 20 inches in length, and 36 inches below top of tank.
4. Monitor Port: Minimum 2 inch steel pipe with locking cap to be used for detecting leaks between primary and outer tanks.
5. Leak Detector System

H. Capacity:

1. Volume: 10000 gallons
2. Dimensions: inches
3. Overall Length: inches

I. Installation:

1. The tank system shall be installed in strict accordance with the manufacturer's instructions and compliant with all applicable fire codes and environmental regulations. State and local permits shall be obtained by the contractor prior to installation.
2. Tank shall be installed on a reinforced concrete support slab which is designed to support a full tank/vault assembly and full capacity of fuel being stored. Contractor must provide protection to the tank from vehicular impact.
3. Tank shall be clearly marked with "No Smoking" and "Flammable" or "Combustible", as well as identifying the product stored.
4. Electrical connections shall be in accordance with all applicable codes and rated for hazardous area as required based upon the product stored. Dispensing operations shall provide an emergency shut-off switch located per code requirements of NFPA. 70 and each system shall be grounded in accordance with NFPA 78 and the Uniform Fire Code.
5. The fill pipe shall be provided with a fill cap, gasket and lock with 2 sets of keys. The vent pipe shall be provided with a vent cap. Provide a gauge on top of the tank.
6. The entire vaulted assembly shall be listed by Underwriter's Laboratories as U.L. 2085 protected type and Southwest Research Institute as S.W.R.I. 93-01 protected tank.
7. The primary tank shall be tested and provided tight against leakage under a test pressure of not less than 3 psi nor more than 5 psi for 1 hour.
8. Fill the storage tank with fuel oil as directed by the Contractor. Replace any fuel at no expense to the Owner, which was used during testing so that the tank is full when project is completed.
9. Access ladder and platform shall be provided per OSHA requirements.
10. Provide additional accessories as indicated on the contract drawings.

2.3 LEAK DETECTION AND MONITORING SYSTEMS

A. Description: Calibrated, leak-detection and -monitoring system, and liquid-level gage system complying with UL 1238 with probes and other sensors and remote alarm panel for fuel-oil storage tanks and fuel oil piping.

B. General

1. The Specifications under this article cover the furnishing and installing of Tank Monitoring Systems including probes, sensors and accessories for:

    a. Aboveground and underground storage tank systems.
    b. Interstitial space liquid monitoring.
    c. Inventory monitoring.
    d. Access manway/piping sump liquid monitoring.
    e. Overfill alarm horn and light with acknowledgment switch.
    f. Pressurized piping line leak detection and shut down.

2. Governing Standards

    a. Governing Standards for Tank Monitoring Systems including probes, sensors, electronic line leak detection and accessories shall be:
        1) EPA Regulations 40 CFR Part 280, Sub Part D.
        2) Certification by an independent Laboratory using EPA Protocol (#EPA/530/UST-90/006) for annual and monthly tank testing.
        3) Certification by independent Laboratory using EPA Protocol (#EPA/530/UST-90/010) for pipe line leak detection systems. Certification should include approvals for hard pipe and flexible piping systems.

3. Material

    a. General
        1) The entire tank monitoring system including console unit, probes, sensors, line leak detectors, float switches, relays, alarms and associated accessories shall be available from one manufacturer and shall include all necessary conduit and wiring.
    b. Monitoring System Console
        1) The monitoring system console shall be INCON TS-1001/2P, TS-1001/4P, TS-2001 or approved equal. It shall be an integrated design for centralized, single system site monitoring be complete with an integral printer and shall allow for adapting future monitoring devices. The monitoring system shall be approved for use with U/G storage tanks containing gasoline, methanol and ethanol blends, diesel fuel, fuel oils (including #4 & #8 oil, and waste oil. The monitoring system shall be configured to suit the nearest quantity of tanks. The TS-1001/2P shall be used for two tanks or less, the TS-1001/4P shall be used for 3 or 4 tank installations and the TS-2001 series shall be used with 5 to 8 tank applications.
    c. The monitoring system console shall be capable of providing monitoring for the following:
        1) Annual Tank Tightness Testing with 0.1 GPH leak rate and a minimum probability of detection of 99.2%.
        2) Continuous Statistical Leak Detection via TS-SCALD.
        3) Discriminating interstitial space monitoring.

4) Discriminating piping sump monitoring with sump full alarm.
5) Discriminating dispenser sump monitoring.
6) Discriminating turbine sump monitoring with sump full alarm.
7) Discriminating ground water monitoring.
8) Vapor well monitors with water detection.
9) Sump monitoring with non-discriminating float switch sensors.
10) Interstitial space monitoring with non-discriminating Electro-Optic sensor.
11) High level monitoring with a float switch device.
12) Internal fax/data modem capability.
13) Wireless electronic line leak detection interface via TS-TGI.
14) Leak sensor inputs (12) or (16) plus expansion via TS-SEM module.
15) Two programmable output relays plus expansion via TS-ROM module.

d. The monitoring system console shall be capable of reporting:
1) Inventory Control including:
a) Water Level/Volume
b) Shift Reports
c) Leak Tests
d) Leak Test Time Estimate
e) Alarm Report & History
f) Hi-Low Level Status
g) Usage Reports
h) Inventory & Reconciliation
i) Delivery History
j) Alarm Status
k) System Configuration
l) Theft Alarm
m) Line Leak Tests
n) Regulatory Reprots
2) Leak Test reporting with PASS, FAIL, and ABORT indicators including:
a) Leak rate slope data.
b) Hourly data.
c) Beginning and ending level, volume and temperature measurements.
d) Pass/Fail @ 3 GPH, 2 GPH reports for line leak detection (optional for line leak detection using TS-TGI interface module).
3) Enhanced In-Tank Leak Detection including:
a) 0.1 gallons per (GPH) Leak Test at a min. 99.2% Accuracy.
b) Statistical continuous automatic leak detection (SCALD) for monthly monitoring requirements (optional).
4) Leak Test Programming including:
a) Programmable and on-demand test capability.
b) Single and multiple tanks.
c) Selectable test frequency of Annual, Monthly, Weekly, Daily, & Specific Date.
5) Programmable Alarm Features including:
a) Leak alarms for tanks/sensors/lines.
b) Overfill.
c) High Level.
d) Low Inventory.
e) High Water.
f) Theft.
6) Data Communications including:
a) RS-232 & RS-422 serial ports.
b) Internal Fax Modem Model TS-FM1.
c) Remove polling capability with an IBM capable PC.

d) Auto-dialing out of alarms and reports.
e) Auto-dialing capability of up to 4 different phone numbers.

4. Probes

a. The Tank Monitoring System shall include an automatic tank gauge (ATG) Probe for inventory monitoring and annual tank tightness testing in each tank. The ATG probe shall be INCON series TSP-LL2 or approved equal. ATG Probes shall be supplied by the same manufacturer as the Monitoring System Console. The probes shall be of Magnetostrictive technology.
1) ATG Probes Shall Also:
a) Be capable of being installed in 2" or 4" tank openings.
b) Be manufactured with a minimum 6 RTD Temperature sensors.
c) Have 316 stainless steel shafts.
d) Probe installation kit INCON Model TPS-K4A shall be of snap cap design to provide for quick installation and removal of probe from the riser pipe.

5. Sensors

a. The Sensors shall be INCON TSP-Series or approved equal. Sensors shall be supplied by the same manufacturer as the monitoring system console and shall be of the non-discriminating type.
1) Non Discriminating Sensors
a) Above Ground Tank Interstitial
(1) TSP-EIS: Electro-optical style liquid sensors for fiberglass and steel interstitial space, DW piping traps, and AST dikes.

b. All discriminating sensors must be microprocessor based and capable of sending digitally encoded status information to the console. Each discriminating type sensor must be able to generate digitally encoded status data to the console for the following alarms:
1) Water detection
2) Hydrocarbon detection
3) Loss of signal
4) Data error
5) ID error
6) Sync error
7) All sensors must be designed fail safe and with self test capability.

6. Overfill Alarm

a. The Tank Monitoring System shall include an Overfill Alarm for each tank.
b. The Overfill Alarm shall be INCON No. TSRA2 or approved equal. It shall be of the same manufacturer as the monitoring system console and shall activate an alarm horn and light when a potential overfill is detected. It shall be equipped with an Alarm Acknowledgment Switch INCON No. TS-RK for driver intervention. Monitoring panel shall be water and weather tight construction.

C. Construction Methods

1. General

a. The Tank Monitoring System, related wiring and accessories shall be installed according to the manufacturer’s instructions, State and Local Codes and the Contract Drawings.

b. All Tank Level Probe wiring shall be Beiden Shielded cable or equal as noted below. All point sensor wiring shall be AWG 18 Ga. THHN wires. Tank level probe wiring and point sensor wiring can be installed in common conduit.
   1) 0-130 feet = Beiden No. 87760
   2) 0-200 feet = Beiden No. 87761
   3) 0-775 feet = Beiden No. 89182

2. Testing, Start-up and Factory Warranty

   a. The Tank Monitoring System shall be fully tested, calibrated and proved operational to the owner prior to acceptance. Start up and programming of monitoring system shall be performed by factory trained technicians. Complete system shall be provided with a full one year factory parts and labor warranty. All warranty verification forms must be submitted to INCON, Saco, ME for proper warranty registration.

2.4 PIPING SPECIALTIES

A. Tank, Pipe Connectors: Comply with UL 567.

B. Piping, Flexible Connectors: Fabricated from materials suitable for fuel-oil service, including 150-psig minimum working-pressure rating, and having threaded ends for 2-inch NPS (DN50) and smaller and flanged ends for 2-½-inch NPS (DN65) and larger.

1. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper tube ends or bronze flanged ends, braze welded to hose.
2. Stainless-Steel-Hose, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

2.5 FUEL-OIL TANK SPECIALTY FITTINGS

A. Fitting Materials: Cast-iron, malleable-iron, brass, or corrosion-resistant metal; suitable for fuel-oil service.

1. Surface, Flush-Mounted Fittings: Waterproof and suitable for fuel-oil truck traffic.
2. Aboveground-Mounted Fittings: Weatherproof.

B. Spill-Containment Fill Boxes: Flush mounting, with drainage feature to drain oil into tank, threaded fill-pipe connection, and wrench operation.

C. Supply and Sounding Drop Tubes: Fuel-oil supply piping or fitting, inside tank, terminating 6 inches above bottom of tank, and with end cut at a 45-degree angle (1:1 slope).

D. Pipe Adapters and Extensions: Compatible with piping and fittings.

E. Suction Strainers, Check Valves, and Overfill Check Valves: Bronze or corrosion-resistant metal components.

F. Foot Valves and Anti-siphon Valves: Poppet-type, bronze or corrosion-resistant metal components.

G. Weatherproof Vent Cap: Increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.6 SOURCE QUALITY CONTROL

A. Perform factory tests, according to UL 142 and STI F911, after fabrication and before shipment.

B. Perform factory test, according to UL 142 and UL 2085, after fabrication and before shipment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Verify excavations are to required grade, dry, and not over-excavated.

C. Verify concrete ballast pad and tank foundation are ready for tank installation.

3.2 EARTHWORK

A. Excavation, Trenching, and Backfilling are specified in Division 31 Sections: “Excavation”, “Trenching” and “Fill”

3.3 PIPING APPLICATIONS

A. Use flanges, unions, transition and special fittings, and valves with pressure ratings same or higher than system’s pressure rating in aboveground and containment sump applications, unless otherwise indicated.

B. Aboveground, Fuel Oil Piping and Vent Piping: Use the following:

1. 2-Inch NPS (DN50) and Smaller: Steel pipe, steel welding fittings, and welded joints, or 2-Inch NPS (DN50) and Smaller: Copper tube, copper fittings, and brazed joints.
2. 2-½- to 4-Inch NPS (DN65 to DN100): Steel pipe, steel welding fittings, and welded joints.

3.4 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves.
2. Throttling Duty: Use ball valves.

3.5 JOINT CONSTRUCTION

A. Refer to Section “Utility Materials” for basic piping joint construction.

B. Make bonded joints for RTRP piping with adhesives according to manufacturer’s written instructions.

3.6 FUEL-OIL STORAGE TANK INSTALLATION

A. Install fuel-oil storage tanks according to manufacturer's written instructions and standards specified.

B. Check factory installed equipment and accessories for loosening during transit.

C. Clean and flush tanks prior to delivery to site. Seal until pipe connections are made.

D. Install aboveground tanks on concrete foundation. Secure with hold-down straps and turnbuckles.

E. Install aboveground tank supports and anchor bolts in accordance with authority having jurisdiction requirements.

F. Install grounding for aboveground tanks in accordance with Division 26

G. Protect aboveground tanks by installing pipe bollards.

H. Install tank bases and supports.

I. Set tanks on bases and supports.

J. Install piping connections to tanks with unions and swing joints. Provide venting in accordance with API 2000.

K. Install ground connections.

L. Seal unused tank openings using threaded pipe plugs, flanges, or caps.

M. Tank Accessories:

1. Install tank accessories shipped loose with tank.
2. Install the following tank accessories: anti-siphon devices, overfill shutoff and alarms, vents, gages, and emergency vents
3. Install tank accessories as indicated on Drawings.

N. Install piping connections.

O. Install tank leak-detection and -monitoring devices.

P. Install containment sumps.

Q. Adjust liquid level gages before initial start-up and after filling of tank.

R. Fill tanks completely at Project turnover with appropriate fuel.

3.7 CONCRETE BASES

A. Construct fuel-oil storage tank concrete-ballast and -surface bases according to tank manufacturer's setting templates for anchor bolt and tie locations. Use 3000 psi (20 700 kPa), 28-day compressive-strength concrete.

B. Construct concrete tank and equipment bases according to supported tank and equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000 psi (20 700 kPa), 28-day compressive-strength concrete.

C. Refer to Division 03 Section: "Cast-in-Place Concrete" for concrete.

3.8 PIPING INSTALLATION

A. Install piping free of sags and bends.

B. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

C. Install fittings for changes in direction and branch connections.

D. Assemble and install bulkhead fittings for pipe penetrations through storage tank sump sidewalls. Follow fitting manufacturer's written instructions and use components required for liquidtight joints.

E. Install reductions in pipe sizes using eccentric reducer fittings. Install fitting with level side down.

F. Install tank, pipe connectors at piping connections to UST.

G. Install piping, flexible connectors at piping connections to vibration-producing equipment. Use according to the following applications:

1. Steel Piping: Stainless-steel-hose, flexible connectors.
2. Copper Tubing: Bronze-hose, flexible connectors.
3. RTRP: Stainless-steel-hose or bronze-hose, flexible connectors.

H. Install double-contained piping according to manufacturer's written instructions for assembly, joining, trench preparation, and installation.

I. Install and terminate double-contained piping at fuel-oil storage tank containment sumps and at building.

3.9 VALVE INSTALLATIONS

A. Install valves in accessible locations. Protect valves from physical damage and install metal tag attached with metal chain indicating fuel oil piping systems.

3.10 CONNECTIONS

A. Connect fuel-oil distribution piping to fuel-oil storage tanks and building fuel oil piping. Use pipe adapters or transition fittings compatible with both piping systems. Refer to Division 22 Section: "Pipes and Tubes for Plumbing Piping and Equipment": for building piping.

B. Connect vent, fill, sounding, gage, and other piping to fittings and specialty devices.

C. Piping Connections: Make piping connections as follows, unless otherwise indicated:

1. Install unions, in piping 2-inch NPS (DN50) and smaller, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.
2. Install flanges, in piping 2-½-inch NPS (DN65) and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
3. Install dielectric unions to connect piping of dissimilar metals.

D. Make connections to liquid-level gage system.

E. Make connections to fuel-oil storage tank leak-detection system.

F. Make electrical connections to pumps, control panels, liquid-level gages, and leak-detection and -monitoring devices.

G. Electrical wiring, disconnect switches, and motor controls are specified in Division 16.

H. Ground equipment and AST.

I. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.11 LIQUID-LEVEL GAGE SYSTEM INSTALLATION

A. Install liquid-level gage systems according to manufacturer's written instructions. Locate panel inside building where indicated.

3.12 LEAK-DETECTION AND -MONITORING SYSTEM INSTALLATION

A. Install leak-detection and -monitoring systems according to manufacturer's written instructions. Install alarm panel inside building where indicated.

1. Fuel-Oil Storage Tanks: Install probes or use factory-installed, integral probes in interstitial space of double-wall tanks.
2. Fuel-Oil Double-Contained Piping: Install leak-detection sensor cable probes in interstitial space of double-contained piping.
3. Install liquid-level gage systems according to manufacturer's written instructions.

B. Install cable on flat surfaces with hold down clips every 8 feet and cable tags every 50 feet

C. Graphic Locator Map: Provide location map with system reflecting actual installation showing system configuration and sensing string layout. Furnish length along cable as references to locate leaks. Base footage on calibration points.

D. Calibration Points: Record calibration points along sensing string in accordance with manufacturer's procedures. Provide sensor cables with cable tags every 50 feet.

E. Direct Buried of Hydrocarbon Sensing Cable:

1. Replace cable damaged during installation.
2. Seal cable ends to prevent moisture ingress.
3. Install cable so connectors are accessible in junction boxes at grade or in manholes, valve pits or other locations.
4. Install cable from underground to grade using PVC pipe.
5. Install on prepared bedding.
6. Backfill cable with 6 inches of sand placed on top of cable and compacted prior to pipe installation.
7. Where cable is to be covered by concrete or other structures, install sensor cable in slotted PVC pipe. Install with access points to allow replacing and servicing.

F. Install Work in accordance with authority having jurisdiction requirements.

3.13 LABELING AND IDENTIFYING

A. Equipment: Install engraved, plastic-laminate equipment nameplates and signs on AST and equipment.

1. Text of Signs: In addition to name of identified unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

B. Piping: Install pipe markers on aboveground piping.

C. Refer to Division 33 Sections: "Utility Identification" and “Identification for Utilities Piping and Equipment”.

D. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes during backfilling of trenches for piping. Locate tapes 6 to 8 inches (150 to 200 mm) below finished grade and directly over piping and edges of each fuel-oil storage tank.

3.14 PAINTING

A. Division 09 Section: "Painting" and “Coating”: For field-painting requirements.

B. Use materials and procedures in "Exterior Paint Schedule" Article's "Ferrous Metal" Paragraph and "Full-Gloss, Alkyd-Enamel Finish" Subparagraph in Division 9 Section "Painting," using color selected by Engineer.

C. Paint AST and metal supports, except units with factory-applied paint or protective coating. Restore damaged finish to original condition.

D. Paint aboveground pipe, fittings, valves, and supports.

3.15 FIELD QUALITY CONTROL

A. Division 01 Section – “Quality Requirements”: Field inspection, testing, adjusting, and balancing.

B. Perform pressure test for tightness, with air, inert gas, or water according to NFPA 30 and NFPA 31 on tanks before installation. Apply soap solution to joints and check for leaks. Do not exceed the following:

1. Tanks Smaller Than 12-Foot (3.7-m) Diameter: 5-psig (34.5-kPa) test pressure.
2. Tanks 12-Foot (3.7-m) Diameter and Larger: 3-psig (20.7-kPa) test pressure.

C. Repair or replace defective tanks and retest until there are no leaks.

D. Test fuel-oil distribution piping according to NFPA 30 and NFPA 31. Remake leaks and defects with new materials and retest until there are no leaks.

E. Field Testing Leak Detection System:

1. Perform tests to demonstrate ability of system to detect and locate breaks, shorts and probes on sensor string.
2. Perform leak testing in accordance with the following procedure to verify operation and ability to work with condensation pools or other static moisture:

    a. Wet sensor cable near start of sensor string and acknowledge detection or location alarm and recheck system.
    b. Wet sensor cable near end of sensor string with first location still wetted and acknowledge detection or location alarm and recheck system.
    c. Wet sensor cable in three additional locations between first and second leak locations with each detection or location alarm being acknowledged and prior leak locations still wetted.
3. Prepare and submit report verifying each leak location and detection accuracy. Furnish history print out of test results from panel. Submit TDR traces for each test run to allow verification of wet locations.
4. Test and adjust leak-detection and -monitoring system controls and devices. Replace damaged and malfunctioning controls and devices.

F. Report test results promptly in writing to Engineer and authorities having jurisdiction.

3.16 MANUFACTURER'S FIELD SERVICES

A. Division 01 - Quality Requirements: Requirements for manufacturer’s field services.

B. Furnish factory trained representative for 8 hours of on-site time during tank installation.

C. Furnish factory trained representative of system supplier for 8 hours of on-site time during leak detection and location system sensor and electronics installation.

D. Furnish factory trained representative for 8 hours of on-site time during final checkout of tanks installation.

E. Furnish factory trained representative of system supplier for 8 hours of on-site time during final checkout of leak detection and location system.

3.17 ADJUSTING

A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

3.18 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section “Commissioning”.

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable

C. Before activating system, perform these steps:

1. Verify that tests have been performed.
2. Open valves to fully open position.
3. Fill fuel-oil storage tanks with specified grade fuel oil.
4. Check leak-detection and -monitoring systems for proper operation.

3.19 DEMONSTRATION

A. Division 01 Section – “Execution and Closeout Requirements”: Requirements for demonstration and training.

B. Engage a factory-authorized service representative for leak-detection system to train Owner's maintenance personnel to adjust, operate, and maintain systems.

1. Train Owner's maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintaining leak-detection equipment and pumps.
2. Review data in maintenance manuals.
3. Schedule training with Owner with at least seven days' advance notice.

END OF SECTION

SECTION 23 23 00
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other Sections of Division 23.

1.2 SUMMARY

A. Section includes:

1. Pipes, tubing, fittings, and specialties.
2. Special duty valves.
3. Refrigerants.
4. Installation of refrigerant piping.
5. Engineered Wall Seal and Insulation Protection System.

B. Products installed but not furnished under this Section include pre-charged tubing, refrigerant specialties, and refrigerant accessories furnished as an integral part of packaged air conditioning equipment.

C. Design and installation shall be provided in accordance with equipment manufacturer’s recommendations.

D. Related Sections: The following sections contain requirements that relate to this section:

1. Division 07 Section: “Firestopping”: Product requirements for firestopping for placement by this section.
2. Division 07 Section: “Joint Sealants” For materials and methods for sealing penetrations through walls.
3. Division 08 Section: “Access Doors and Frames”: Access Doors for concealed valves and accessories
4. Division 09 Section: “Painting and Coating”: Product requirements for painting for placement by this section
5. Division 23 Section: "Common Work Results for HVAC": Labeling and identification of refrigerant piping.
6. Division 23 - HVAC Insulation: Product requirements for Piping Insulation for placement by this section.
7. Division 23 Section: “Hangers and Supports for HVAC Piping and Equipment.”
8. Division 23 Section: “Identification for HVAC Piping and Equipment.”
9. Division 23 Section: “Vibration and Seismic Controls for HVAC Piping and Equipment.” Product requirements for Vibration Isolation for placement by this section.
10. Division 26 Section: “Raceways and Boxes for Electrical Systems”: Requirements of conduits and boxes housing electrical connections specified by the section.

1.3 REFERENCES

A. Air-Conditioning and Refrigeration Institute:

1. ARI 495 - Refrigerant Liquid Receivers.
2. ARI 710 - Liquid-Line Driers.
3. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter Dryers.
4. ARI 750 - Thermostatic Refrigerant Expansion Valves.
5. ARI 760 - Solenoid Valves for Use with Volatile Refrigerants.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

C. American Society of Mechanical Engineers:

1. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
3. ASME B31.5 - Refrigeration Piping.

D. ASTM International:

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
3. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
4. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
5. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
6. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.

E. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
2. AWS D1.1 - Structural Welding Code - Steel.

F. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

G. Underwriters Laboratories Inc.:

1. UL 429 - Electrically Operated Valves.

1.4 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.

B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves or equipment.

C. Provide pipe hangers and supports in accordance with ASME B31.5, ASTM F708, MSS SP 58, MSS SP 69, and MSS SP 89.

D. Flexible Connectors: Use at or near compressors where piping configuration does not absorb vibration.

1.5 SUBMITTALS

A. Division 01 Section: “Submittal Procedures”: Submittal Procedures.

B. Product data for the following products:

1. Each type valve specified.
2. Each type refrigerant piping specialty specified.

C. Submit Shop Drawings showing:

1. The design and layout of refrigerant piping, valves, expansion valves, heat recovery boxes, branch selector boxes, drains, accumulators, traps, hot gas bypass, filters, and miscellaneous specialties, etc.
2. Pipe and tube sizes, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment connection details.
3. Interface and spatial relationship between piping and proximate to equipment.

D. Provide a letter from the equipment manufacturer certifying the refrigerant pipe layout indicated on the refrigerant pipe shop drawing is being provided in accordance with the equipment manufacturer’s criteria including layout, pipe length, pipe offsets, and pipe size.

E. Brazer's Certificates signed by Contractor certifying that Brazer’s comply with requirements specified under "Quality Assurance" below.

F. Maintenance data for refrigerant valves and piping specialties, for inclusion in Operating and Maintenance Manual specified in Division 01 and in Division 23 Section: "Common Work Results for HVAC.”

G. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories.
2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
4. Refrigerant Specialties: Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes for the following:

    a. Refrigerant moisture and liquid indicators.
    b. Refrigerant strainers.
    c. Refrigerant pressure regulators.

d. Refrigerant pressure relief valves.
e. Refrigerant filter-driers.
f. Refrigerant solenoid valves.
g. Refrigerant expansion valves.
h. Electronic expansion valves.

H. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

I. Test Reports: Indicate results of refrigerant leak test and piping system pressure test.

J. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.

K. Manufacturer's Certificate: Certify Products meet or exceed specified requirements

L. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

M. Comply with VOC limitations under section 099100.

N. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.6 CLOSEOUT SUBMITTALS

A. Division 01 Section: “Execution and Closeout Requirements”: Closeout procedures.

B. Project Record Documents: Record actual locations of valves, equipment and refrigerant accessories.

C. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

1.7 QUALITY ASSURANCE

A. Qualify brazing processes and brazing operators in accordance with ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications".

B. Perform Work in accordance with authority having jurisdiction and AWS D1.1 for welding hanger and support attachments to building structure.

C. Regulatory Requirements: Comply with provisions of the following codes:

1. ANSI B31.5: ASME Code for Pressure Piping - Refrigerant Piping, latest edition.
2. ANSI/ASHRAE Standard 15: Safety Code for Mechanical Refrigeration, latest edition.
3. International Mechanical and Plumbing Codes, latest edition.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

C. Design piping system and hangers and supports under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.9 PRE-INSTALLATION MEETINGS

A. Division 01 Section: “Administrative Requirements”: Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section: “Product Requirements”: Product storage and handling requirements.

B. Dehydrate and charge refrigeration components including piping and receivers, seal prior to shipment. Maintain seal until connected into system.

C. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section: “Product Requirements”.

B. Do not install underground piping when bedding is wet or frozen.

1.12 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.13 COORDINATION

A. Division 01 Section: “Administrative Requirements”: Requirements for coordination.

B. Coordinate the installation of roof piping supports and roof penetration with Division 07.

1.14 WARRANTY

A. Division 01 Section: “Execution and Closeout Requirements”: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for valves excluding packing.

1.15 MAINTENANCE MATERIALS

A. Division 01 Section: “Execution and Closeout Requirements”: Spare parts and maintenance products.

B. Furnish two refrigerant oil test kits each containing everything required for conducting one test.

1.16 EXTRA MATERIALS

A. Division 01 Section: “Execution and Closeout Requirements”: Spare parts and maintenance products.

B. Furnish two packing kits for each size and valve type.

C. Furnish two refrigerant filter-dryer cartridges of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Refrigerant Valves and Specialties:

a. Alco Controls Div, Emerson Electric.
b. Danfoss Electronics, Inc.
c. EATON Corporation, Control Div.
d. Henry Valve Company.
e. Parker-Hannifin Corporation, Refrigeration and Air Conditioning Division.
f. Sporlan Valve Company.

2.2 PIPE AND TUBING MATERIALS

A. General: Refer to Part 3, Article "Pipe Application" for identification of systems where the below specified pipe and fitting materials are used.

B. Drawn-Temper Copper Tubing: ASTM B 280, Type ACR, hard-drawn straight lengths, and soft-annealed coils, seamless copper tubing. Tubing shall be factory cleaned, ready for installation, and have ends capped to protect cleanliness of pipe interiors prior to shipping.

C. Annealed-Temper Copper Tubing: ASTM B280, Type ACR

1. Contractor Option: Pre-Insulated Line Sets

a. UL-Recognized
b. ASTM C-534 and ASTM E-84
c. Closed Cell Elastomeric
d. UV Resistant Rated Insulation

2.3 FITTING AND JOINING MATERIALS

A. Fitting Materials

1. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern.

B. Joining Materials

1. Brazing Filler for Joining Similar Metals: AWS A5.8, Classification BCuP series, with melting range from 1190 to 1480°F.
2. Brazing Filler for Joining Dissimilar Metals: AWS A5.8, Classification BAg series, with melting range from 1125 to 1370°F.

C. ACR Press Fittings – Contractor Option

1. ACR fittings shall be refrigerant grade copper fitting suitable for brazing or mechanically sealed/pressed ACR fittings as manufactured by Conex Banninger.
2. Fitting body shall consist of Refrigerant grade copper per ASTM-B8280 with internal NHBR sealing element. Mechanical press shall be of 3 point design. MaxiPro fittings shall incorporate hook lockingseal on top of fitting cup and pressed with Rothenberger approved press jaws. Fitting shall be supplied contaminant free in vapor sealed bags direct from factory. Fittings shall be marked with 48 bar or 700PSI and certified to UL-109, UL-207, and ASHRAE-15. Installing contractor shall be factory trained and owner shall receive 5 year warranty on all pressed connections. Proof of training shall be provided to owners rep at beginning of project.

2.4 VALVES

A. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.

B. General: Complete valve assembly shall be UL-listed and designed to conform to ARI 760.

C. Ball Valves:

1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals, soldered ends.
2. Maximum working pressure: 700 psig
3. Maximum working temperature: 325 degrees F

D. Check Valves - Smaller Than 7/8 inch: 700 psig maximum operating pressure, 300 °F maximum operating temperature; cast brass body, with removable piston, Teflon seat, and stainless steel spring; straight through globe design. Valve shall be straight through pattern, with solder-end connections.

E. Check Valves - 7/8 inch and Larger: 700 psig maximum operating pressure, 300°F maximum operating temperature; cast bronze body, with cast bronze or forged brass bolted bonnet; floating piston with mechanically retained Teflon seat disc. Valve shall be straight through or angle pattern, with solder-end connections.

F. Solenoid Valves: ARI 760, 250°F temperature rating, 700 psig working pressure; forged brass, with Teflon valve seat, two-way straight through pattern, and solder end connections. Provide manual operator to open valve. Furnish complete with NEMA 1 solenoid enclosure with 1/2 inch conduit adapter, and 24 volt, 60 Hz. normally closed holding coil.

G. Evaporator Pressure Regulating Valves: pilot-operated, forged brass or cast bronze; complete with pilot operator, stainless steel bottom spring, pressure gage tappings, 24 volts DC, 50/60 Hz, standard coil; and wrought copper fittings for solder end connections.

H. Thermal Expansion Valves: thermostatic adjustable, modulating type; size as required for specific evaporator requirements, and factory set for proper evaporator superheat requirements. Valves shall have copper fittings for solder end connections; complete with sensing bulb, a distributor having a side connection for hot gas bypass line, and an external equalizer line.

I. Refrigerant Pressure Relief Valves: Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB; for standard 700 psig setting; selected to ASHRAE 15.

J. Hot Gas Bypass Valve: adjustable type, sized to provide capacity reduction beyond the last step of compressor unloading; and wrought copper fittings for solder end connections.

K. Electronic Expansion Valves

1. Brass bodies with flared or solder connection, needle valve with floating needle and machined seat, stepper motor drive.
2. Evaporation Control System: Electronic microprocessor based unit in enclosed case, proportional integral control with adaptive superheat, maximum operating pressure function, pre-selection allowance for electrical defrost and hot gas bypass.
3. Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low), solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.

2.5 REFRIGERANT PIPING SPECIALTIES

A. General: Complete refrigerant piping specialty assembly shall be UL-listed and designed to conform to ARI 760.

B. Strainers: 700 psig maximum working pressure; forged brass body with monel 80-mesh screen, and screwed cleanout plug; Y-pattern, with solder end connections.

C. Moisture/liquid Indicators: 700 psig maximum operation pressure, 200°F maximum operating temperature; forged brass body, with replaceable polished optical viewing window, and solder end connections.

D. Filter-driers: ARI 710, 700 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel capscrews, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter-drier core kit, including gaskets, as follows:

1. Standard capacity desiccant sieves to provide micronic filtration.

E. Suction Line Filter-Drier: ARI 710, 700 psig maximum operation pressure, 225°F maximum operating temperature; steel shell, and wrought copper fittings for solder end connections. Permanent filter element shall be molded felt core surrounded by a desiccant for removal of acids and moisture for refrigerant vapor.

F. Suction Line Filters: 700 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel capscrews, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter core kit, including gaskets, as follows:

G. Flanged Unions: 700 psig maximum working pressure, 330°F maximum operating temperature; two brass tailpiece adapters for solder end connections to copper tubing; flanges for 7/8 inch through 1-5/8 inch unions shall be forged steel, and for 2-1/8 inch through 3-1/8 inch shall be ductile iron; four plated steel bolts, with silicon bronze nuts and fiber gasket. Flanges and bolts shall have factory-applied rust-resistant coating.

H. Flexible Connectors: 700 psig maximum operating pressure; seamless tin bronze or stainless steel core, high tensile bronze braid covering, solder connections, and synthetic covering; dehydrated, pressure tested, minimum 7 inch in length.

I. Suction Accumulators: Provide as manufactured by Refrigeration Research, Inc.

J. Refrigerant Receivers

1. Internal Diameter 6 inch and Smaller: ARI 495, UL listed, steel, brazed; 700 psig pressure rating, with taps for inlet, outlet, and pressure relief valve.
2. Internal Diameter 6 inch and Larger: ARI 495, welded steel, tested and stamped in accordance with ASME Section VIII; 700 psig with taps for liquid inlet and outlet valves, pressure relief valve, and magnetic liquid level indicator.

2.6 REFRIGERANT: Type shall be provided to suit equipment being served.

2.7 LOCKING ACCESS PORT CAPS

A. Provide locking cap(s) with multi-key(s) for all refrigerant circuit access ports located outdoors.

B. Locking caps shall be as manufactured by Win Air Company or comparable acceptable product.

2.8 ENGINEERED WALL SEAL AND INSULATION PROTECTION SYSTEM:

A. Provide a combined 2-in-1 protection system to be provided and installed for sealing wall penetrations of HVAC refrigerant line and protecting the refrigerant line set piping insulation. System basis of design shall be AIREX Pro-System Kit™ or a comparable acceptable product. The use of a combined sustainable compression gasket and seal system shall meet the requirements of the energy codes, to seal refrigerant line wall penetrations to prevent wall air-leakage, moisture intrusion, weather intrusion, rodent intrusion, vibration control, physical wall damage, when connecting with refrigerant piping or thermal insulated refrigerant piping.

B. FLEXIBLE PVC PLASTIC COVERS: Provide Flexible PVC Plastic UV/Weather Protective Cover for Pipe Insulation. Basis of design shall be as manufactured by AIREX E-FLEX GUARD™ by Airex Manufacturing Inc. shall be provided and installed, the pipe insulation UV/protective cover shall feature an outdoor industrial grade combined method with molecular bonding and an integral pre-fastening system that allows removable/ reusable use for maintenance and full-enclosure including cut to length capabilities without the use of adhesives as an attachment in any way shape or form including either in the protectors construction or the protectors installation or on any attachment to pipe insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section: “Administrative Requirements”: Coordination and project conditions.

B. Examine rough-in for refrigerant piping systems to verify actual locations of piping connections prior to installation.

C. Verify excavations are to required grade, dry, and not over excavated.

3.2 PREPARATION

A. Pre-Cleaning:

1. Before installation of copper tubing other than Type ACR tubing, clean the tubing and fitting using following cleaning procedure:

    a. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through the tubing by means of a wire or an electrician’s tape.
    b. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
    c. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
    d. Finally, draw a clean, dry, lintless cloth through the tube or pipe.

3.3 INSTALLATION - INSERTS

A. Provide inserts for placement in concrete forms.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Hangers, supports, and anchors are specified in Division 23 Section: "Hangers and Supports for HVAC Piping and Equipment."

3.5 INSTALLATION OF VALVING

A. General: Install refrigerant valves where indicated, and in accordance with manufacturer's instructions.

B. Install globe valves on each side of strainers and driers, in liquid and suction lines at evaporators, and elsewhere in accordance with manufacturer’s instructions.

C. Install a full sized, 3-valve bypass around each drier.

D. Install solenoid valves ahead of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at the top.

1. Electrical wiring for solenoid valves is specified in Division 26. Coordinate electrical requirements and connections.

E. Thermostatic expansion valves may be mounted in any position, as close as possible to the evaporator.

1. Where refrigerant distributors are used, mount the distributor directly on the expansion valve outlet.
2. Install the valve in such a location so that the diaphragm case is warmer than the bulb.
3. Secure the bulb to a clean, straight, horizontal section of the suction line using two bulb straps. Do not mount bulb in a trap or at the bottom of the line.
4. Where external equalizer lines are required, make the connection where it will clearly reflect the pressure existing in the suction line at the bulb location.

F. Install pressure regulating and relieving valves as required by ASHRAE Standard 15.

3.6 PIPING APPLICATION

A. Provide Type ACR drawn copper tubing with wrought copper fittings and brazed joints above ground, within building. Provide Type K, annealed temper copper tubing for 2 inch and smaller without joints, within enclosed areas. Mechanical fittings (crimp or flair) are not permitted.

1. Install annealed temper tubing in pipe duct. Vent pipe duct to the outside.

3.7 INSTALLATION OF PIPING

A. Route piping parallel to building structure and maintain gradient.

B. Install piping to conserve building space, and not interfere with use of space.

C. Group piping whenever practical at common elevations.

D. Sleeve pipe passing through partitions, walls and floors.

E. Install pipe identification

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide access where valves and fittings are not exposed.

H. Arrange refrigerant piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

I. Flood refrigerant piping system with nitrogen when brazing.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

K. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.

L. Install valves with stems upright or horizontal, not inverted.

M. Insulate piping and equipment

N. Provide replaceable cartridge filter-dryers, with isolation valves and bypass with valve.

O. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

P. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

Q. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

R. Provide electrical connection to solenoid valves.

S. Fully charge completed system with refrigerant after testing.

T. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.

U. Install refrigerant piping in accordance with ASME B31.5.

V. Size piping and install refrigerant piping, traps, specialties as necessary for a complete and operational system in accordance with equipment manufacturer's recommendations.

W. General: Install refrigerant piping in accordance with ASHRAE Standard 15 "The Safety Code for Mechanical Refrigeration". Unless specified otherwise by the Section, comply with "Installation of Piping - General" as specified in Division 22 Section; "Pipes and Tubes for Plumbing Piping and Equipment" and Division 23 Section: "Pipes and Tubes for HVAC Piping and Equipment."

X. Install piping in as short and direct arrangement as possible to minimize pressure drop.

Y. Install piping for minimum number of joints using as few elbows and other fitting as possible.

Z. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.

AA. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.

BB. Insulate suction lines. Liquid lines are not required to be insulated, except where they are installed adjacent and clamped to suction lines, where both liquid and suction lines shall be insulated as a unit.

1. Do not install insulation until system testing has been completed and all leaks have been eliminated.

CC. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.

DD. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

EE. Slope refrigerant piping as follows:

1. Install horizontal hot gas discharge piping with 1/2" per 10 feet downward slope away from the compressor.
2. Install horizontal suction lines with 1/2" per 10 feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.
3. Install traps and double risers and where required in accordance with equipment manufacturer's recommendations to entrain oil in vertical runs.
4. Liquid lines may be installed level.

FF. Use fittings for all changes in direction and all branch connections.

GG. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

HH. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

II. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

JJ. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

KK. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

LL. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6" shall be steel; pipe sleeves 6" and larger shall be sheet metal.

MM. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Refer to Division 07 for special sealers and materials.

NN. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.

OO. Install strainers immediately ahead of each expansion valve, solenoid valve, hot gas bypass valve, compressor suction valve, and as required to protect refrigerant piping system components.

PP. Install moisture/liquid indicators in liquid lines between filter/driers and thermostatic expansion valves and in liquid line to receiver.

1. Install moisture/liquid indicators in lines larger than 2 1/8" OD, using a bypass line.

QQ. Install unions to allow removal of solenoid valves, pressure regulating valves, expansion valves, and at connections to compressors and evaporators.

RR. Install flexible connectors at the inlet and discharge connection of compressors.

SS. Refrigerant circuit access ports located outdoors shall be fitted with locking-type-tamper-resistance caps.

3.8 INSTALLATION - REFRIGERANT SPECIALTIES

A. Refrigerant Liquid Indicators:

1. Install line size liquid indicators in main liquid line downstream of condenser.
2. When receiver is provided, install line size liquid indicators in liquid line downstream of receiver.
3. Install line size liquid indicators downstream of liquid solenoid valves.

B. Refrigerant Valves:

1. Install service valves on compressor suction and discharge.
2. Install gage taps at compressor inlet and outlet.
3. Install gage taps at hot gas bypass regulators, inlet and outlet.
4. Install check valves on compressor discharge.
5. Install check valves on condenser liquid lines on multiple condenser systems.

6. Install refrigerant charging valve in liquid line between receiver shut-off valve and expansion valve.

C. Strainers:

1. Install line size strainer upstream of each automatic valve.
2. Where multiple expansion valves with integral strainers are used, install single main liquid-line strainer.
3. On steel piping systems, install strainer in suction line.
4. Install shut-off valves on each side of strainer.

D. Install pressure relief valves on ASME receivers. Install relief valve discharge piping to terminate outdoors.

E. Filter-Dryers:

1. Install permanent filter-dryers in low temperature systems.
2. Install permanent filter-dryer in systems containing hermetic compressors.
3. Install replaceable cartridge filter-dryer vertically in liquid line adjacent to receivers.
4. Install replaceable cartridge filter-dryer upstream of each solenoid valve.

F. Solenoid Valves:

1. Install in liquid line of systems operating with single pump-out or pump-down compressor control.
2. Install in liquid line of single or multiple evaporator systems.
3. Install in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.

3.9 CONSTRUCTION

A. Pipe Joints:

1. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

   a. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
   b. CAUTION: When solenoid valves are being installed, remove the coil to prevent damage. When sight glasses are being installed, remove the glass. Remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties before brazing. Do no apply heat near the bulb of the expansion valve.
2. Fill the pipe and fittings during brazing, with an inert gas (i.e., nitrogen or carbon dioxide) to prevent formation of scale.
3. Heat joints using oxy-acetylene torch. Heat to proper and uniform brazing temperature.

B. Equipment Connections:

1. The Drawings indicate the general arrangement of piping and fittings.
2. Install piping adjacent to machine to allow servicing and maintenance.

3.10 REFRIGERANT PIPING SYSTEMS

A. Inspect, test and perform corrective action of refrigerant piping in accordance with ASME Code B31.5, Chapter VI, “Refrigerant Piping and Heat Transfer Components”, 2001, and as follows:

1. All refrigerant tubing shall be tested before tube insulation is applied.
2. Note: The use of compressed air for pressure testing refrigerant tubing will not be permitted.
3. Refrigerant relieve valves, if installed, shall be removed prior to pressure testing and shell openings plugged. After system is tested and found to be completely tight, relief valves shall be reinstalled prior to system evacuation.
4. Each tubing system shall be pressure tested with dry nitrogen. Leaks shall be repaired by removing and remaking the defective joint. No caulking will be permitted. After repair of leaks, system shall be retested and provided tight.
5. Tubing shall be tested per refrigerant manufacturer’s recommendations. Tubing shall be tested at a minimum of 550 psig on the high side and on the low side. Do not exceed manufacturer recommendations.
6. Repair leaking joints using new materials, and retest for leaks.

3.11 FIELD QUALITY CONTROL

A. Division 01 Section: “Quality Requirements and Execution and Closeout Requirements”: Field inspecting, testing, adjusting, and balancing.

B. Test refrigeration system in accordance with ASME B31.5.

C. Repair leaks.

D. Retest until no leaks are detected.

3.12 ADJUSTING AND CLEANING

A. Verify actual evaporator applications and operating conditions, and adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

B. Clean and inspect refrigerant piping systems in accordance with industry standards.

C. Adjust controls and safeties. Replace damaged or malfunctioning controls and equipment with new materials and products.

3.13 ENGINEERED WALL SEAL AND INSULATION SYSTEM

A. The wall seal outlet shall be comprised of an elastomeric sleeve and stainless steel clamp. The connecting refrigerant lines exposed to weather shall be thermal insulated. All pipe insulation material (whether it is exterior surface coated or non-coated) shall be completely covered and protected from sunlight, moisture, equipment maintenance, wind, snow, ice, rodent damage, physical damage, and shall provide shielding from solar radiation that can cause degradation of the material.

3.14 FLEXIBLE PVC PLASTIC COVERS:

A. All pipe insulation material (whether it is exterior surface coated or non-coated) must be completely covered and protected. THE USE OF ANY ADHESIVES IS NOT PERMITTED FOR THIS APPLICATION. Insulation Protector shall be tested and meet the following testing: ASTM E 96 (Vapor Transmission of Materials), ASTM G 153 (Carbon Arc Light Exposure – Accelerated Weathering), ASTM D 412 (Tensile Strength after UV Exposure and Water Immersion), ASTM 570 (Water Absorption of Plastics), ASTM E 84 (Surface Burning Characteristics of Building Materials), ASTM G 21 (Fungal Growth). UV/Protector Pipe Insulation Material shall meet Class II vapor retarder per ASTM E 96 (vapor/moisture permeability test) “1 perm or less”. Wrapping Tape or Adhesive Tape shall not be permitted as per energy codes.

3.15 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section “Commissioning”.

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable

C. Charge system using the following procedure:

1. Install core in filter dryer after leak test but before evacuation.
2. Evacuate refrigerant system with vacuum pump; until temperature of 35°F is indicated on vacuum dehydration indicator.
3. During evacuation, apply heat to pockets, elbows, and low spots in piping.
4. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.
5. Break vacuum with refrigerant gas; allow pressure to build up to 2 psi.
6. Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.

D. Train Owner's maintenance personnel on procedures and schedules related to start-up and shut-down, troubleshooting, servicing, and preventative maintenance of refrigerant piping valves and refrigerant piping specialties.

E. Review data in Operating and Maintenance Manuals. Refer to Division 01 Section: "Execution and Closeout Requirements."

F. Schedule training with Owner through the Architect, with at least seven (7) days advance notice.

END OF SECTION

SECTION 23 30 00
HVAC AIR DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specifications, apply to this section, and all sections of Division 23.

1.2 SUMMARY

A. Section includes:

1. Duct Materials
2. Duct Applications
3. Duct Systems Fabrication
    a. General
    b. Crossbreaking or Cross Beading
    c. Rectangular Duct Fittings
    d. Transverse Duct Connection
    e. Manufactured Turning Vanes
    f. Round Branch Fittings
    g. Spin-in Fittings
    h. Splitter Dampers
    i. Hangers and Supports
    j. Sealing Materials
    k. Casings
4. Duct Sound Lining
5. Single Wall Spiral Round Ducts
6. Double Wall Spiral Insulated Round Ducts
7. Flexible Duct
8. Flexible Duct Connectors
9. Air Devices
10. Ductwork Accessories
    a. Backdraft Dampers
    b. Manual Volume Control Dampers
    c. Duct Access Doors
11. Instrument Test Ports
12. Duct Thermometers
13. Smoke Detectors
14. Fire-Stopping
15. Fire Dampers
16. Ceiling Fire Dampers
17. Louvers
18. Louver Blank-Off Panels
19. Ductwork Painting

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 03 Sections: “Cast-in-Place Concrete: Requirements for concrete encasements and curbs specified by this section.
2. Division 09 Section: “Painting and Coatings”: Requirements for painting or coating as specified in this Section.
3. Division 23 Section: “HVAC Insulation”: Execution requirements for insulation as specified by this Section.
4. Division 23: Common Motor Requirements for HVAC Equipment:
5. Division 23 Section: “Instrumentation and Control for HVAC”: Product requirements for connection and control of Combination Smoke and Fire Dampers for placement as specified by this Section.
6. Division 26 Section: “Low Voltage Electrical Power Conductors and Cables”: Requirements for electric wiring and connection to devices and units as specified by this Section.
7. Division 26 Section: “Raceways and Boxes for Electrical Systems”: Requirements of conduits and boxes housing electrical wiring and connections as specified by this Section.

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”)

A. Abbreviations and Acronyms

1. ATC – Automatic Temperature Control
2. BMS – Building Management System
3. UBC – Usage Based Controls

B. American National Standards Institute

1. ANSI/ASHRAE ® 135-2001: BACnet – A Data Communication Protocol for Building Automation Systems (including standard and all published addenda).

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE Handbook - Fundamentals.
2. ASHRAE 70 – Method of Testing for Rating the Performance of Air Outlets and Inlets.
3. ASHRAE/ANSI 130, Methods for Testing Air Terminal Units.

D. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.
2. AWS D1.2 - Structural Welding Code - Aluminum.
3. AWS D9.1 - Sheet Metal Welding Code.

E. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A90 - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.

3. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
4. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
5. ASTM A568 - Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
6. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
7. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
8. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
9. ASTM A1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
10. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
11. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.
12. ASTM E1 – Standard Specification for ASTM Thermometers.
13. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

F. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
3. NFPA 92A – Recommended Practice for Smoke-Control Systems.

G. International Code Council:

1. International Energy Conservation Code (IECC).
2. International Mechanical Code (IMC).

H. Sheet Metal and Air Conditioning Contractors' National Association:

1. SMACNA 016 - HVAC Air Duct Leakage Test Manual.
2. SMACNA 1966 - HVAC Duct Construction Standards - Metal and Flexible.
3. SMACNA “Duct Cleanliness for New Construction Guidelines”.

I. Underwriters Laboratories Inc.:

1. UL 181 - Factory-Made Air Ducts and Connectors.
2. UL 181A - Closure Systems for Use With Rigid Air Ducts.
3. UL 555 – Standard for Safety for Fire Dampers.
4. UL 555C – Standard for Safety for Ceiling Dampers.
5. UL 586 – High –Efficiency Particulate, Air Filter Units.
6. UL 900 – Air Filter Units.

J. American Refrigeration Institute:

1. ARI 880 – Performance Rating of Air Terminals.

2. ARI 885 – Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.
3. ARI 850 – Commercial and Industrial Air Filter Equipment.

K. National Electrical Manufacturers Association:

1. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).

L. Air Movement and Control Associations:

1. AMCA 500 – Test Methods for Louvers, Dampers, and Shutters.

1.4 DEFINITIONS OF SEAMS AND JOINTS FOR FIELD FABRICATED DUCTWORK

A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:

1. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints. Seams also refer to circumferential seams on manufactured fittings.
2. Joints: Joints include girth joints; branch and sub branch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without alteration of system performance, including increasing the system total pressure.

B. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission of Architect/Engineer.

C. Size round ducts installed in place of rectangular ducts according to ASHRAE Handbook - Fundamentals.

1.6 PREINSTALLATION MEETINGS

A. Division 01 Section: “Administrative Requirements”: Requirements for pre installation meeting.

B. Convene minimum two weeks prior to commencing Work of this Section.

1.7 SUBMITTALS

A. Division 01 Section: “Submittal Procedures”: Submitted procedures.

B. Product data including performance data and manufacturers technical details of construction relative to materials, weights, dimensions of individual components, schedules for each type of air devices, terminal units, etc. (fire dampers, etc.) with location/designation/size/model number, profiles, accessories and finishes for the following items:

1. Duct Materials
2. Duct Applications and Sealing
3. Duct Systems Fabrication
    a. General
    b. Crossbreaking or Cross Beading
    c. Rectangular Duct Fittings
    d. Transverse Duct Connection
    e. Manufactured Turning Vanes
    f. Round Branch Fittings
    g. Spin-in Fittings
    h. Splitter Dampers
    i. Hangers and Supports
    j. Sealing Materials
    k. Casings
4. Duct Sound Lining
5. Double Wall Spiral Insulated Round Ducts
6. Flexible Duct
7. Flexible Duct Connectors
8. Air Devices
9. Ductwork Accessories
    a. Backdraft Dampers
    b. Manual Volume Control Dampers
    c. Duct Access Doors
10. Instrument Test Ports
11. Duct Thermometers
12. Smoke Detectors
13. Fire-Stopping
14. Fire Dampers
15. Ceiling Fire Dampers
16. Louvers
17. Louver Blank-Off Panels
18. Ductwork Painting

C. Maintenance data for volume control devices, fire dampers, smoke dampers and combination fire/smoke dampers, in accordance with Division 15 Section and Division 01.

D. Test Reports:

1. Indicate pressure tests performed, including date, section tested, test pressure, and leakage rate according to SMACNA 016.

E. Shop Drawings:

1. Submit duct fabrication drawings, drawn to scale not smaller than 1/4 inch equals 1 foot, on sheets same size as Contract Drawings, indicating following:

    a. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other Work.
    b. Duct layout that further indicates pressure classifications and sizes in plan view; exhaust duct systems that further indicate classification of materials handled as specified in this Section.
    c. Fittings.
    d. Reinforcing details and spacing.
    e. Seam and joint construction details.
    f. Penetrations through fire-rated and other walls.
    g. Hangers and supports, including methods for vibration isolation and building and duct attachment.

F. Manufacturer’s Certificate: Certify products meet or exceed specified requirements.

G. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS qualification within previous 12 months.

H. Manufacturer’s Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.

I. Manufacturer Instructions:

1. Submit detailed instructions on installation requirements, including storage and handling procedures.
2. Submit special procedures for glass-fiber ducts.

J. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.
3. Welders: Qualify procedures and personnel according to AWS D1.1 for hangers and supports, AWS D1.2 for aluminum supports, and AWS D9.1 for duct joint and seam welding.

K. Comply with VOC limitations under section 099100.

L. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.8 CLOSEOUT SUBMITTALS

A. Division 01 Section: “Execution and Closeout Requirements”: Closeout Procedures.

B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data/procedure.

C. Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices, in accordance with Division 23 Section and Division 01

1.9 QUALITY ASSURANCE

A. Installer: A firm with at least 5 years experience on projects with low pressure ductwork system, CAV, DOAS and VRF units, etc. similar to this project.

B. NFPA Compliance; Comply with:

1. NFPA 90A, “Standard for the Installation of Air Conditioning and Ventilating Systems, “for system components.
2. NFPA 90B, “Standard for the Installation of Warm Air Heating and Air Conditioning Systems”.

C. U.L. Compliance; comply with:

1. U.L. Standard 181, Class 1 for flexible ductwork.
2. Furnish labeled fire dampers; in accordance with Underwriters Laboratories (UL) Standard 555 “Fire Dampers and Ceiling Dampers” furnish labeled smoke dampers in accordance with UL Standard 555S “Leakage Systems.” Furnish duct liner that meets the erosion test as detailed in UL Publication 181.

D. ARI Compliance; Comply with:

1. Test and rate air outlets and inlets in accordance with ARI 650 “Standard for Air Outlets and Inlets”.

E. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 “Method of Testing for Rating the Air Flow Performance of Outlets and Inlets”.

F. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 “Certification, Rating and Test Manual”.

G. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.

H. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 “Test Method for Louvers, Dampers and Shutters”.

I. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.

J. SMACNA Compliance: Comply with SMACNA duct construction standards (high, medium and low pressure) latest editions as of date of issue of these specifications.

1. Perform Work according to SMACNA 1884 and 1966.

K. Dampers tested, rated and labeled in accordance with the latest UL requirements.

L. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

M. Manufacturers shall be regularly engaged in manufacture of components listed herein with characteristics, sizes, capacities and finished required, and whose products have been proven satisfactory in use for a period of not less than five years.

1.10 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

C. Welders: AWS qualified within previous 12 months for employed weld types.

D. Licensed Professional: Professional engineer experienced in design of specified Work and licensed at Project location

1.11 DELIVERY, STORAGE AND HANDLING

A. Division 01 Section: “Product Requirements”: Product Storage and handling requirements.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Deliver sealant and fire-stopping materials to site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

E. Store and handle sealant fire-stopping materials in compliance with manufacturers’ recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

F. Deliver and store stainless steel sheets on exposed ducts, care shall be taken to minimize scratches and marks caused by manufacturing and installation process.

G. Deliver diffusers, grilles, registers, transfer air devices, etc. wrapped in factory fabricated fiberboard type containers. Each container on outside of container shall include the equipment tag, type of diffuser, griller, register, transfer etc. or air terminal location to be installed and special handling/stacking requirements. Avoid crushing or bending of containers in any way. Prevent dirt or debris, rain, etc, from entering the container during shipment, handling and storage.

H. Store equipment and devices in original cartons and protect from weather, construction work traffic, and vandalism. Where possible, all equipment/terminals, etc. shall be stored indoors. When necessary to store products outdoors, store above grade on pallets or in trailers and enclose with waterproof wrapping to protect from moisture and weather damage.

I. Protect dampers from damage to operating linkages and blades.

J. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

K. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

L. Covers on all containers shall be removed in time to eliminate the possibility of mold growth due to moisture.

1.12 AMBIENT CONDITIONS

A. Division 01 Section: “Temporary Facilities and Controls”: Requirements for ambient condition control facilities for product storage and installation.

B. Minimum Conditions: Do not install duct sealant when temperatures are less than those recommended by sealant manufacturer.

C. Subsequent Conditions: Maintain temperatures during and after installation of duct sealant.

1.13 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

B. Indicate field measurements on Shop Drawings.

1.14 COORDINATION

A. Division 01 Section: “Administrative Requirements”: Coordination and project conditions.

B. Coordinate Work where appropriate with building control Work.

1.15 WARRANTY

A. Refer to Division 01 Section: “Execution and Closeout Requirements”: for product warranties and product bonds.

B. Furnish five year manufacturer’s warranty for ducts and air terminal units.

1.16 EXTRA MATERIALS

A. Division 01 Section: “Execution and Closeout Requirements”: Spare parts and maintenance products.

B. Furnish two of each size and type of fusible link.

PART 2 - PRODUCTS

2.1 DUCT MATERIALS

A. Galvanized Steel Ducts: ASTM A653 galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90.

B. Steel Ducts: ASTM A568, A1008, or A1011

C. Fasteners: Rivets, bolts, or sheet metal screws.

D. Hanger Rod: ASTM A36; galvanized steel continuously threaded.

E. Carbon Steel Sheet: Where indicated, provide carbon steel complying with ANSI/ASTM A 1008. Carbon steel sheet shall be equal to Armco, Toncan or Youngstown.

F. Reinforcing Shapes and Plates: Unless otherwise indicated, provide galvanized steel reinforcing where installed on galvanized sheet metal ducts. For aluminum and stainless steel ducts provide reinforcing of compatible materials.

G. Tie Rods: Galvanized steel. ¼-inch minimum diameter for 36-inch length or less; 3/8-inch, minimum diameter for lengths longer than 36 inches.

H. Security Bars and Frames: Furnish and install security bars and frames with the materials indicated on the drawings.

1. Penetrations Through Interior Security Walls: Bars shall be 7/8” diameter tool resistive steel (Rockwell C-61), spaced at 6” on center vertical, and 12” on center horizontal, set in 2” by 3/8” flat steel retaining bars. Weld retaining bars to head and sill plates.
2. Penetrations Through Exterior Security Walls and Roof: Bars shall be 7/8” diameter tool resistive steel (Rockwell C-61), spaced at 5” on center one way with angle frame embedded in the precast concrete.

I. General: Furnish and install miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and sizes necessary to comply with duct system requirements, including proper connection of ductwork and equipment.

2.2 DUCT APPLICATIONS AND SEALING

Static-Pressure and Seal Classes: Unless otherwise indicated, construct according to the following:

DUTY	**DUCT SYSTEM**	**SMACNA PRESSURE CLASS (INCHES WG)**	**GAGE PRESSURE**
Supply	Supply Fan to Terminal Box	4”	Positive
Supply	Terminal Box to Terminal Diffuser/Grille/Register	2”	Positive

Supply	Supply Fan to Terminal Diffuser/Grille/Register	3”	Positive
Return/Exhaust	Terminal Box to Return Fan/Exhaust Fan	4”	Negative
Return/Exhaust	Terminal Equipment (Diffuser/Grille/Register) To Return/Exhaust Box	2”	Negative
Return/Exhaust	Terminal Equipment (Diffuser/Grille/Register) To Return Fan/Exhaust Fan	3”	Negative
Outdoor Air	All Outdoor Air Ductwork	2”	Negative
Relief Air	All Relief Air Ductwork	2”	Positive
Transfer Air	All Transfer Air Ductwork	1”	Neutral

1. Provide 18 gauge minimum duct construction for the first ten (10) feet of supply and return ducts connected to all air handling units. Additionally, provide 18 gauge minimum duct construction for all ductwork located in shafts, including top and bottom elbows/tees.

B. Duct Sealing:

1. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in “Duct Schedule” Article according to SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible”. All ducts shall be completely sealed.
2. All ducts shall be sealed. As a minimum, seal ducts to the following seal classes according to SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible”:

Type	**SMACNA PRESSURE CLASS (INCHES WG)**	**Positive or Negative Service**	**Seal Class**	**Leakage Class**
Rectangular Metal	2”	Negative	C	24
Rectangular Metal	3”	Negative	B	12
Rectangular Metal	4”+	Negative	A	6
Round Metal	2”	Negative	C	12
Round Metal	3”	Negative	B	6
Round Metal	4”+	Negative	A	3
Round or Rectangular Metal	2”	Positive	C	6
Round or Rectangular Metal	3”	Positive	B	3
Round or Rectangular Metal	4”+	Positive	A	2

2.3 DUCT SYSTEMS FABRICATION

A. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel or aluminum; in accordance with SMACNA 1966 "HVAC Duct Construction Standards," Latest Edition, Tables 2-1 through 2-52, including their associated details. Conform to the requirements

in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.

1. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
2. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
3. Make allowance for internal duct lining where required.
4. Determine duct gauges for the longest duct side and use for all 4 sides. Joints and reinforcing requirements apply to the longest duct side.
5. Reinforce all ducts to prevent buckling, vibration or noise as recommended in the referenced construction standards and as required to suit the installed conditions.
6. Do not crossbreak duct which will receive rigid insulation covering.
7. Where tap sizes of divided flow fittings are not indicated, make branch and main connection sizes proportional to their respective air flows and maintain uniform transverse velocities in the fittings.
8. Make radius elbows and radius tee connection with throat radius equal to or greater than 1-1/2 centerline width of the duct. Use vaned elbows where shown and where radius elbows will not fit the space in all square bends.
9. Turning vanes shall be the airfoil type with extended trailing edges 36" maximum length. Where longer vanes are required, use 2 or more sets of vanes with intermediate runners securely fastened together.
10. Bolts, screws, rivet or spot weld reinforcing members securely to the duct on not less than 6" centers.
11. Where ducts are open ended without grilles, registers or other means of stiffening, reinforce and stiffen the open end with standing seams or an angle frame.
12. Paint all cut ends on galvanized angles, rods and other uncoated surfaces with aluminum paint.
13. Where ductwork is not painted or otherwise finished, remove all exposed traces of joint sealers, manufacturer's identification and other markings.
14. Refer to paragraph 2.26 B for Manual Volume Control Dampers specification.

B. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20 gauge or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standard," Figures: 4-1 and 4-2, unless they are lined or are externally insulated.

C. Rectangular Duct Fittings: Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," Latest Edition, Figures 2-1 through 2-10.

1. Slide-on Transverse Joint Connectors
   Prefabricated slide-on transverse duct connectors and components will be accepted.

   a. Duct constructed using prefabricates systems will refer to the manufacturer’s guidelines for sheet gauge, intermediate reinforcement size and spacing and proper joint reinforcement(s).
   b. Manufacturers of prefabricated systems must have duct construction and reinforcement guidelines along with supporting independent leakage and deflection performance testing. Manufacturer’s prefabricated systems printed assembly and installation procedures must be adhered to during all phases.
   c. All components of prefabricated system must be clearly embossed with manufacturer’s marking and systems manufacturer clearly identified on all duct

labels. No substitution of system components is permitted. Approved Manufacturer: Ductmate Industries or Ward Duct Connectors Incorporated “W.D.C.I.”

D. Transverse Duct Connection System

1. Manufacturers:

   a. Ductmate Industries, Inc.
   b. TDC
   c. MEZ Industries

2. Furnish materials in accordance with all applicable codes, standards and local authorities having jurisdiction requirements. Provide SMACNA recommended rigidity class connections, interlocking angle and duct edge connection systems with sealant gaskets, cleats, and corner clips.
3. All transverse joints and intermediate reinforcement on rectangular ducts shall be as shown in SMACNA standards. Transverse joints shall be selected consistent with the specified pressure classification, material and other provisions for proper assembly of ductwork.

   a. Slide-on Flanges:
      1) Description: Add on factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
      2) Material: galvanized steel, Stainless 304 or 316, Aluminum, Aluminized, PVC coated, Galvannealed, or Black Iron.
      3) Gauge and Shape: For duct constructed using prefabricated systems, refer to the manufacturer’s guidelines for sheet gauge, intermediate reinforcement size and spacing, and proper joint reinforcement.
      4) Manufacturers or prefabricated systems must provide duct construction and reinforcement guidelines along with independent testing for leakage, deflection, and seismic performance.
      5) Independent leakage testing must be for operating pressures of 10 inch wg positive and negative.
      6) Manufacturer’s prefabricated systems printed assembly and installation procedure must be adhered to at all times.
      7) Manufacturer’s procedures must include fastener and clean spacing along with details for all system variations including break-away and roofing connections.
      8) All manufactured system components must be clearly embossed with manufacturer’s name or markings. No substitution of manufacturer’s system components is permitted.
   b. Longitudinal Seams: Select seam types and fabricate according to SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible”, Figure 2-2, “Rectangular Duct/Longitudinal Seams”, for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible”.
   c. Elbows, Transitions, Offsets, Branch Connections, and other Duct Construction: Select types and fabricate according to SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible”, Chapter 4, “Fittings and Other Construction” for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provision in SMACNA’s “HVAC Construction Standards – Metal and Flexible”.

4. Casings

a. Fabricate casings in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible and construct for operating pressures indicated.
b. Reinforce access door frames with steel angles tied to horizontal and vertical plenum supporting angles. Furnish hinged access doors where indicated or required for access to equipment for cleaning and inspection. Furnish clear wire glass observation ports, minimum 6 x 6 inch size.
c. Fabricate acoustic casings with reinforcing turned inward. Furnish 16 gage back facing and 22 gauge perforated front facing with 3/32 inch diameter holes on 5/32 inch centers. Construct panels 3 inches thick packed with 4.5 lb./cu ft minimum glass fiber media, on inverted channels of 16 gage.

E. Manufactured Turning Vanes:

1. Furnish and install single thickness, multiple radius, airfoil steel turning vanes. Static pressure loss for square ducts shall be no more than 20% of velocity head. Turning vanes shall be furnished with a mounting plate to facilitate installation in ductwork. Turning vanes shall be Harper double wall turning vanes fabricated from the same material as the duct. Turning vane front and back panels shall be securely locked together with adequate crimping to prevent twisting of vane. Vane shall be capable of withstanding 250 pounds of tensile load when secured according to the manufacturer's instruction. Rails for mounting turning vanes shall have self locking friction fit tabs designed to facilitate proper alignment of vanes. Tab spacing shall be as specified in Figure 4-3 of the 2005 SMACNA Manual, "HVAC Duct Construction Standards, Metal & Flexible" Third Edition standard. Rail systems with non-compliant tab spacing shall not be accepted. Acoustical Turning Vane: Shall be used in applications that required quiet operating systems. Mounting rails shall have friction insert tabs that align the vanes automatically. Turning vanes shall be Tuttle and Bailey Model AOOA, Ductmate "PRO-rail," or acceptable comparable product.

F. Round Branch Fittings:

1. Provide take off fittings manufactured with airtight seams using a locking double seam. Units shall be constructed of 26 gauge galvanized steel (minimum). Units shall have a factory installed volume damper with locking spring loaded quadrant. Damper regulator shall be elevated 2" to allow for insulation thickness. Fitting shall be conical type as described on the plans with a base mounting flange secured by a minimum of four sheet metal screws or pop-rivets. See drawings for alternate "Streamline" branch take-off fittings. All High Efficiency Take-Offs, Conicals, and Collars must have a factory applied gasket along all rivets, co-latches, and flange. All fittings shall be constructed from a minimum of 26 gauge steel. All dampered fittings must have low-leakage hardware with closed-end bearings. Manufacturer: Ductmate Industries "GreenSeam Fittings" or acceptable comparable product.

G. Spin-in Fittings

1. Furnish and install spin-in fittings where indicated on the contract drawings, Royal Metal Products Model No. 168 or acceptable comparable product, provide with balancing damper as manufactured by Duro Dyne, Ductmate Industries or acceptable comparable product.

a. Material shall be of same construction as duct main.

H. Splitter Dampers

1. Provide splitter dampers in accordance with SMACNA Standards as manufactured by Titus, Hart & Cooley or approved equal. Dampers shall be of steel construction and shall be provided with manual adjusting lever and locking device.

I. Hangers and Supports

1. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4 inches thick.
2. Hangers: Galvanized sheet steel, or round, uncoated steel, threaded rod.
    a. Hangers Installed In Corrosive Atmospheres: Electro galvanized, all thread rod or hot dipped galvanized rods with threads painted after installation.
    b. Straps and Rod Sizes: Conform with Table 5-1, 5-1M, 5-2 in SMACNA HVAC Duct Construction Standards, Latest Edition, for sheet steel width and gage and steel rod diameters.
3. Duct Attachments: Sheet metal screws, blind rivets, or self tapping metal screws, compatible with duct materials.
4. Trapeze and Riser Supports: Steel shapes conforming to ASTM A 36.
    a. Where galvanized steel ducts are installed, provide hot –dipped- galvanized steel shapes and plates.
    b. For stainless steel ducts, provide stainless steel support materials.
    c. For aluminum ducts, provide aluminum support materials, except where materials are electrolytically separated from ductwork.
5. Aircraft cable hanging system with easy lightweight mechanical adjustment system may be used for hanging HVAC and other mechanical applications. Aircraft cable and mechanical hanger shall have a 5 to 1 safety factor. Manufacturers: Ductmate Industries “Clutcher” Cable Hanging System, Gripple, Inc. Cable Hanger System, Erico CADDY SPEED LINK, or acceptable comparable product.
    a. Cable hanging systems with adjustable mechanical devices shall be compliant with SMACNA HVAC duct construction standards, and the authority having jurisdiction’s requirements.

J. Sealing Materials

1. Joint and seam sealants:
    a. UL-723
    b. Maximum flame spread of 0 and maximum smoke development of 0
    c. Seal to 15” water gauge and meet the requirements of all SMACNA seal classes
    d. Application method: Brush, spray, or caulk.
    e. Solid Content: Minimum 68% +/-2%
    f. Water resistant
    g. Mold and mildew resistant
    h. Service: Indoor and outdoor
    i. Static pressure rating: 15” water gauge
    j. VOC: 0 g/l
    k. LEED: Meets LEED v4 requirements or later
    l. Emissions: Certified compliant under CDPH V1.1 small chamber emissions testing
    m. Other requirements: Meet FDA, USDA, and EPA standards

n. UL 181 B-M listed
o. Acceptable manufacturers: Design Polymerics DP 1010, Ductmate Industries Proseal, or Hardcast Inc. IG-601 Iron Grip

2. Flanged gasket

a. Gasket size: 5/8” x 3/16”, no exceptions
b. UL 723
c. Maximum flame spread of 5 and maximum smoke development of 5
d. For use in TDC and TDF flanges
e. Mold and mildew resistant
f. Solid content: 100%
g. Water resistant
h. Elongation 600%
i. Service temperature: -40F to +245F
j. Other requirements: Meet FDA, USDA, and EPA standards
k. Acceptable manufacturers: Design Polymerics DP 1040 or Ductmate Industries 440 Butyl gasket tape.

3. Seam sealant

a. For use in Pittsburg, button punch, and snap lock seams
b. Non-curing and non-shrinking
c. Permanently flexible
d. Pumpable
e. Water resistant
f. Service temperature: -40F to +200F
g. Acceptable manufacturers: Design Polymerics seam sealant or Ductmate Industries 5511M.

K. Casings

1. Fabricate casings in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible and construct for operating pressures indicated.
2. Reinforce access door frames with steel angles tied to horizontal and vertical plenum supporting angles. Furnish hinged access doors where indicated or required for access to equipment for cleaning and inspection. Furnish clear wire glass observation ports, minimum 6 x 6 inch size.
3. Fabricate acoustic casings with reinforcing turned inward. Furnish 16 gage back facing and 22 gauge perforated front facing with 3/32 inch diameter holes on 5/32 inch centers. Construct panels 3 inches thick packed with 4.5 lb./cu ft minimum glass fiber media, on inverted channels of 16 gage.

2.4 DUCT SOUND LINING

A. Rectangular Ductwork

1. Products:

a. K-Flex Gray Duct Liner with PSA
b. Armacell AP/Coilflex
1) Material shall have a density ranging from 3 to 6 lb/ft^3 (ASTM D1622, ASTM D3575).

2) Material shall have a maximum thermal conductivity (k) of 0.25 Btu-in/hr-ft²-°F @ 75°F mean temperature (ASTM C518, ASTM C177). AP Coilflex and AP Armaflex have a k-value at 1.5" of 0.28, slightly larger than 0.25. (AP Coilflex has a k-value of 0.25 at 1", AP Armaflex k-value of 0.245 at 1".
3) Material shall have a maximum Water Vapor Transmission rate of 0.10 Perm-in. (ASTM E96, Desiccant Method).
4) Material shall have a minimum sound absorption coefficient (NRC) of 0.50 at a nominal 1" thickness (ASTM C423). AP Coilflex is 0.60, AP Armaflex is 0.40.
5) Material shall have a flame spread rating not greater than 25 and a smoke developed rating not greater than 50 when tested in accordance with ASTM E84 at a thickness required to attain a minimum 6 R-value.
6) Material shall have a minimum R-value of 6 at a nominal 1 ½" thickness.
7) Application of K-Flex gray duct liner with PSA shall be per manufacturer's recommendations and per SMACNA requirements.
8) Low VOC adhesive to meet South Coast AQMD Rule 1168. Armaflex 520BLV (low VOC) meets this Rule 1168.
9) Duct liners shall not break away, flake off, or show evidence of delamination at velocities of 10,000 ft/min per ASTM C1071.

B. Round/Oval Ductwork: Insulation material shall be a flexible, closed-cell or conformable, elastomeric insulation in sheet form as manufactured by Armacell: AP Spiralflex or a comparable acceptable product. This product shall meet the requirements as defined in ASTM C 534, Grade 1 Type II, "Specification for performed elastomeric cellular thermal insulation in sheet and tubular form".

1. Insulation materials shall be manufactured without the use of CFC's, HFC;s or HCFC's. It is also formaldehyde-free, low VOCs, fiber free, dust free and resists mold and mildew.
2. The insulation material shall conform to meet the requirements as defined in ASTM C 1534, Standard "Specification for Flexible Polymeric Foam Sheet Insulation Used as a Thermal and Sound Adsorbing Liner for Duct Systems"
3. Materials 1" thickness and below, shall have a flame spread index of less than 25 and a smoke developed index of less than 50 when tested in accordance with ASTM E 84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, the flame shall not be progressive and all materials shall pass simulated end-use fire tests.
4. Materials shall have a maximum water absorption rate of 0/2% (% by volume), when tested in accordance with ASTM C 209.
5. The material shall be manufactured under an independent third party supervision testing program covering the properties for fire performance, thermal conductivity and water vapor transmission.
6. Materials shall be approved for air plenums.
7. Materials shall meet NFPA 90A, NFPA 90B and UL 181 Class 1 specification.
8. Materials shall meet ASTM C 411. Materials to perform up to 250°F.
9. Pertinent Duct Lining Specification Compliance.
10. Sound lining shall adhere to:

    a. ASTM C 1071 – Erosion Resistance.
    b. ASTM G 21 – Fungi Resistance.
    c. ASTM C 1338 – Fungi Resistance.
    d. ASTM G 22 – Bacterial Resistance.
    e. ASTM C 665 – Non Corrosiveness and no objectionable odors.
    f. NRC rating 0.40 – Test Method ASTM C 423 with ASTM E 795 Type A Mounting.

11. Sound lining shall be dust free and fiber free. Non particulating.
12. AP Spiralflex shall be applied to the inside of round ducts according to the installation guide written specifically for the AP Spiralflex.

2.5 DOUBLE WALL SPIRAL INSULATED ROUND DUCTS

A. Fabrication Requirements: All oval duct shall meet SMACNA “HVAC Duct Construction Standards – Metal and Flexible” – current edition.

B. Manufacturers:

1. McGill AirFlow Corporation
2. Semco Incorporated
3. Tangent Air Corp.
4. Spiral Mfg. Co., Inc.
5. Eastern Sheet Metal, LLC
6. TNT Manufacturing
7. Linx Industries.
8. Ductmate Industries.

C. Furnish materials in accordance with all applicable codes, standards and local authorities having jurisdiction requirements.

D. Transverse Joints: Select joint types according to SMACNA “HVAC Duct Construction Standards – Metal and Flexible” – current edition. Utilize Figure 3-2 – “Transverse Joints - Round Duct”.

1. Transverse Joints larger than 36” diameter – Flanged.

a. All exposed Duct and Unexposed Duct 36 inch to 72 inch Diameter. Three-piece, gasket flanged joint consisting of two internal flanges, with integral mastic sealant, and one external closure ring, for connecting the internal flanges and securing the closed cell neoprene gasketing in place.

E. Product Description: Machine made from round spiral lockseam duct.

F. Galvanized steel outer wall where ductwork is concealed. Where exposed, all outer wall is to be Galvaneal heat treating – “annealing” process for applying by others. As an alternative “chem-treat dry and oil free with water based lubricants.

G. Interstitial Insulation: 2 inch thick glass fiber insulation conforming to ASTM C 1071, NFPA 90A, or NFPA 90B, and with NAIMA AH124.

1. Maximum Thermal Conductivity: .27 Btu x 1n./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Insulation shall be coated with an anti-microbial coating. Note: a liner, between the fiberglass and the perforated liner can be coated in lieu of the insulation.
3. Install spacers that position the inner duct at uniform distance from the outer wall without compressing insulation.
4. Manufacturers include but are not limited to:

a. Knauf

b. Johns-Manville
c. Owens Corning
d. Certainteed.

H. Inner Duct: Minimum 0.028” perforated galvanized steel having 3/32” diameter perforations, with an overall open area of 23% unless noted otherwise. This project calls for solid galvanized steel inner wall; fittings manufactured with solid inner wall.

I. Construct round duct with the following minimum gages:

Diameter	Gauge
2 inches to 14 inches	26

J. Construct fittings with the following minimum gauges:

Diameter	Gauge
2 inches to 14 inches	24

2.6 FLEXIBLE DUCT

A. Air Devices to Supply/Return Branch Ducts:

1. Flexible ductwork shall be Atco UPC #036 or comparable acceptable product, UL listed for Class 1 Air Ducts, Standard 181. Ducts shall be rated for positive pressure of 10" W.G. and negative pressure of 2” W.G. per UL 181.
2. Description:

   a. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helical-wound spring steel wire.
   b. Insulation: Fiberglass.
   c. Vapor Barrier Film: polyethylene
   d. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
   e. Maximum Velocity: 4,000 fpm
   f. Temperature Range: Minus 20 to plus 210 degrees F
3. Limit flexible duct 6' maximum. Install flexible ducts, using all recommended fittings, couplings and accessories. Support ducts with wide straps spaced so that horizontal runs do not sag more than 3" in 3'. Cover with duct tape and fasten with duct strap clamps. 180^{o} bends in flexible duct are prohibited.

B. Flexible Duct Elbow Supports:

1. Flexible Duct Elbow Supports shall be Build Right Products-Flex® or comparable acceptable product.

   a. Universal-mount 1-piece, fully adjustable, radius-forming brace to support 4-inch through 16-inch diameter flexible air ducts.
   b. Classified: UL 2043.
   c. Material: 100 percent recycled copolymer polypropylene.
   d. Support Frame Radius: 8 inches.
   e. Compliance for Flexible Duct Radius:
      1) SMACNA HVAC Duct Construction Standards.

2) ASHRAE Advanced Energy Design Guides.
3) ADC Flexible Duct Performance and Installation Standards.

2.7 FLEXIBLE DUCT CONNECTORS

A. Indoor Installation: UL listed fire retardant neoprene or vinyl-coated woven fiberglass fabric. Minimum density 30 oz./sq. yd. Rated to constant maximum temperature of 200 deg. F.

1. Acceptable Manufacturers, subject to compliance with requirements:

a. VentFabrics, Inc, model “Ventglas”.
b. Duro-Dyne Corp, model 10012 MF6N Specification Grade Neoprene, Super Metalfab.”
c. Ductmate Industries, Inc., model PROflex.

2.8 AIR DEVICES

A. General:

1. Furnish and install air devices where indicated on the contract drawings. Diffusers, registers and grilles shall be of sizes, shapes, capacities and types as indicated on the contract drawings, as required for a complete installation.
2. Performance: Provide diffusers, registers, and grilles that have, as minimum, throw, pressure drop, and noise criteria ratings for each size device as listed in manufacturer’s current data.
3. Ceiling Compatibility: Provide diffusers, registers and grilles with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling system with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems, which will contain each type of ceiling air diffuser.
4. For flush mounting, diffuser housing shall be mounted above ceiling surface with flush perimeter flange and gasket to seal against ceiling.
5. For lay-in mounting, diffuser housing shall be sized to fit between ceiling exposed suspension tee bars and rest on top surface of tee bar.
6. For wet or humid areas the air devices shall be of aluminum construction.

B. Air device selections are based on manufacturers Model numbers indicated on the contract drawings. The following products of: Titus, Hart & Cooley, Greenheck, Kruger, Metalaire, US Aire, Price (Basis of Design), Nailer, or Tuttle & Bailey, Inc. will be accepted provided they meet application, performance and design criteria requirements.

C. Diffusers, registers and grilles shall be furnished with factory installed adjustable baffles to provide air patterns shown on the plans.

D. Air distribution devices have been specifically selected based on Price performance data. If devices are submitted, other than those specified, the submittal must include an item by item selection of substitutions listed by space location. This list must include model number, size, air pattern, airflow, pressure drop, throw, NC noise level, finish and mounting method for both the submitted and specified device. Where compliance with performance required different dimensions, such as neck or ace size, than the specified item, the submittal must note where these dimension changes occur listing both the original and new dimensions.

E. Finishes of all air devices shall be baked on enamel, colors shall be selected by Architect.

F. Where air terminal devices are installed in duct collars or branches, furnish and install air extractors. Furnish and install control grids, volume dampers and/or other accessories necessary to ensure uniform air flow across the terminal devices. Accessories shall be of the same material as the terminal device. Install fixed blade terminals so that blades block the normal line of vision. Furnish 3 of each type of removable key operators.

2.9 DUCTWORK ACCESSORIES

A. Backdraft Dampers

1. General

   a. Provide and install factory fabricated backdraft dampers suitable for horizontal or vertical installations.
   b. Frame construction shall be based upon individual application and based on manufacturer's installation instructions for each damper assembly.
   c. Mill finish is standard unless specified otherwise.

2. Manufacturers

   a. Subject to compliance with requirements, provide dampers of one of the following:
      1) Ruskin Manufacturing.
      2) American Warming and Ventilating.
      3) Greenheck Corporation.
   b. Model numbers and features listed below are based on Ruskin Manufacturing.

3. Light to Medium Duty Backdraft Damper (1000 to 1500 FPM maximum velocity)

   a. Frame: 6063T5 extruded aluminum, 0.090" wall thickness, mitered corners.
   b. Blades: (1000 FPM maximum velocity) - Ruskin BD2/A1, 0.025" formed aluminum, extruded vinyl edge seals. (1500 FPM maximum velocity) - Ruskin BD2/A2, 6063T5 extruded aluminum, 0.050" wall thickness, extruded vinyl edge seals.
   c. Bearings: Synthetic.
   d. Linkage: Concealed in frame.
   e. Temperature limits: -40°F to +200°F.
   f. Operational pressures: BD2A1 blades open at 0.03 in. wg. and are fully open at 0.10 in. wg. BD2A2 blades open at 0.10 in. wg. and are fully open at 0.15 in. w.g.
   g. Accessories:
      1) Rear mounted bird screen.
      2) Kynar finish.
      3) Baked enamel finish.
      4) (Color and finish selection by Architect/Owner)

4. Heavy Duty Backdraft Damper (1500 to 2500 FPM maximum velocity)

   a. Frame: 6063T5 extruded aluminum, 0.0125" wall thickness, galvanized steel braced corners.
   b. Blades: 6063T5 extruded aluminum, 0.070" wall thickness, mechanically locked extruded vinyl blade edge seals. Ruskin Model BDG.
   c. Bearings: Synthetic.
   d. Linkage: ½" tiebars with stainless steel pivot pins.
   e. Temperature limits: -40°F to +200°F.
   f. Operational pressures:

1) BDG blades open at 0.12 in. wg. and are fully open at 0.20 in. wg.

g. Accessories:
1) Rear mounted bird screen.
2) Adjustable static pressure control.
3) Kynar finish.
4) Baked enamel finish.
5) (Color and finish to be selected by Architect/Owner)

5. Counterbalanced Backdraft Damper

a. Frame: 6063T5 extruded aluminum, 0.090" wall thickness, mitered corners with 12 gauge galvanized braces.
b. Blades: 0.025" roll formed aluminum with extruded vinyl blade seals mechanically locked into blade edge.
c. Bearings: Synthetic.
d. Linkage: χ" x ½" aluminum tiebars concealed in frame.
e. Counterbalance: Zinc plate steel weights, field adjustable.
f. Temperature limits: -40°F to +200°F.
g. Operational pressures:
h. CBD2 to relieve at 0.02 in. wg.
i. Accessories:
1) Kynar finish.
2) Baked enamel finish.
3) (Color and finish to be selected by Architect/Owner)

B. Manual Volume Control Dampers

1. General:

a. Provide factory-fabricated volume-control dampers, complete with required hardware and accessories. Stiffen damper blades to provide stability under operating conditions. Provide locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class. Provide end bearings or other seals for ducts with pressure classifications of 3 inches or higher. Extend axles full length of damper blades. Provide bearings at both ends of operating shaft. All dampers shall be provided with shaft seals to prevent air leakage.
b. Where damper or splitter control rods extend through finished walls or ceilings, terminate rods in approved access box equal to Young No. 1 surface mounted quadrant regulator.
c. All splitter rods shall be provided with Young No. 656-3/8" or 659 – ½" end bearings using two (2) bearings per splitter damper.
d. All ducts larger than 12 x 12 shall be provided with opposed blade dampers.
e. For square ductwork smaller then 12x12 utilize the following damper:
1) Control dampers meeting the following specifications shall be furnished and installed where shown on plans and/or as described in schedules.
2) Damper blades shall be 16 ga. Galvanized steel 3V type with three longitudinal grooves for reinforcement. Blades shall be completely symmetrical relative to their axle pivot point, presenting identical resistance to airflow and operation in either direction through the damper (blades that are non-symmetrical relative to their axle pivot point or utilize blade stops larger than ½ inch are unacceptable). Blade seals shall to TPE. Linkage shall be blade-to-blade concealed in jamp (out of the airstream) to protect linkage and reduce pressure drop and noise.

3) Damper frame shall be 16 ga. galvanized steel formed into a structural hat channel shape with reinforced corners to meet 11 ga. criteria. Bearings shall be corrosion resistant, permanently lubricated, synthetic (acetal) sleeve type rotating in extruded holes in the damper frame for maximum service. Axles shall be square and positively locked into the damper blade. Jamp seals shall be flexible stainless steel compression type to prevent leakage between blade end and damper frame.
4) The damper manufacturer's submittal data shall certify all air leakage and air performance pressure drop data in licensed in accordance with the AMCA Certified Rating Program for Test Figures 5.2, 5.3 and 5.5. Damper air performance dat shall be developed in accordance with the latest edition of AMCA Standard 500-D.
5) Basis of design shall be Greenheck model VCD-23, comparable products as manufactured by Ruskin or American Warming and Ventilation may submitted for consideration.

f. For Round Ductwork 12" in. Diameter and Smaller Utilize the following damper:
1) Round control dampers meeting the following specifications shall be furnished and installed where shown on plans and/or as described in schedules. Dampers shall consist of 20 ga. galvanized steel frame, blades fabricated from 20 ga. galvanized steel, and ½ in. dia. plated steel axles turning in bronze bearings and EPDM blade seals.
2) Damper manufacturer's printed application and performance data including pressure, velocity, and temperature limitations shall be submitted for approval velocities to 3,000 fpm temperatures to 250°F and leakage to 4cfm/ft^2 @ 1 in. wg.
3) Testing and rating to be in accordance with AMCA Standard 500-D.
4) Basis of design shall be Greenheck model VCDR-53, comparable products as manufactured by Ruskin or American Warming and Ventilation may be submitted for consideration.

2. Manufacturers:

a. Subject to compliance with requirements, provide dampers of one of the following:
1) Ruskin Manufacturing.
2) American Warming & Ventilating
3) Greenheck Corporation

b. Model numbers and features listed below are based on Ruskin Manufacturing.

3. Standard Duty Manual Volume Dampers:

a. Frame: 16 gauge galvanized steel structural hat channel with reinforced tabbed corners.
b. Blades: 6" wide, single skin, 16 gauge galvanized steel with three longitudinal grooves for reinforcement.
c. Linkage: Concealed in frame, out of the airstream.
d. Axles: ½" plated steel hex, positively locked.
e. Bearings: Molded synthetic, corrosion resistant.
f. Blade seals: PVC coated polyester fabric mechanically locked into the blade edge. Jamb seals shall be flexible metal between blade and frame.
g. Control shaft: ½" diameter, removable steel shaft.
h. Maximum system velocity: 1500 FPM.
i. Temperature range: -25□F to +180□F.
j. Maximum system pressure:
1) 48" width = 2.5 in. wg.
2) 36" width = 3.0 in. wg.

3) 24" width = 4.0 in. wg.
4) 12" width = 5.0 in. wg.

k. Selection based on Ruskin Model No. CD36.

l. Application: Parallel blade for mixing air streams and exhaust air duty. Opposed blade for outdoor air ductwork upstream of air monitoring station and adjacent to intake louvers suitable for horizontal or vertical installations.

4. Damper End Switch

a. Refer to Division 23 Section “Instrumentation and Control for HVAC.”

5. Damper Actuators

a. Refer to Division 23 Section “Instrumentation and Control for HVAC.”

C. Furnish and install access doors and/or panels in high and low pressure ducts, where indicated or required to provide access for control devices, including but not limited to; control dampers, fire dampers, smoke dampers, airflow monitoring stations, etc.

1. Access doors in low velocity ducts shall be equal to Prefco CAD-101 or Ductmate “Square Framed Access Doors.” Doors shall have galvanized steel frame, with 1” thick, 1-1/2 pcf fiberglass insulation with 24 gauge galvanized steel inner and outer panels. Doors shall be furnished with cam locks.
2. Doors shall be rated for installation in duct systems with pressures up to 8 in w.g. Where required for fire dampers, doors shall be furnished as a factory fabricated unit along with extended sleeve and fire damper (installed downstream of fire damper). Frame shall be 20 gauge galvanized steel with reinforced corners. Doors shall be 20 gauge galvanized steel sheet with 1” inch thick foil faced duct liner insulation, sandwiched to 22 gauge perforated inner line. Door panels shall have spring clips designed to relieve a minimum of 150 cfm at 2 ½” negative. Panels shall be: 10” x 10” on ducts less than 12” diameter; 12” x 18” on ducts from 12” to 24” diameter; and 18” x 18” on ducts from 26” to 36” diameter.

2.10 INSTRUMENT TEST PORTS

A. Furnish and install instrument test ports in the ductwork to allow use of pilot tube traverses in testing and balancing air systems. Install ports in each main, submain and branch main of all systems including supply, return and exhaust. Place holes on more than 2 sides of larger ducts if required by available pilot tube length. Equip holes with Ventlok #699 instrument ports. Fittings shall extend beyond duct covering.

2.11 DUCT THERMOMETERS

A. Duct thermometers shall be Johnson Service Co., Powers Regulator Co. or approved equal, 4½" dial, 2°F divisions, cast aluminum case, mercury actuated, brass movement, 8' copper averaging bulb with bronze braided armor, stainless steel connecting tube as required.

B. Duct thermometers shall be furnished and installed at air handling units as follows:

LOCATION	RANGE
Outdoor Air Duct	-40°F to 120°F

Return Air Duct	30°F to 180°F
Mixed Air Plenum	30°F to 180°F
Supply Air Duct	30°F to 180°F

2.12 SMOKE DETECTORS

A. Smoke detectors and associated wiring shall be provided under Division 26 and located and installed under Division 23.

2.13 FIRE-STOPPING

A. Fire-Resistant Sealant: Provide two-part, foamed-in-place, fire-stopping silicone sealant formulated for use in a through-penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

B. Fire-Resistant Sealant: Provide one-part elastomeric sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

C. Products: Subject to compliance with requirements, provide one of the following:

1. “Dow Corning Fire Stop Foam”; Dow Corning Corp.
2. “Pensil 851"; General Electric Co.
3. “Dow Corning Fire Stop Sealant”; Dow Corning Corp.
4. “3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
5. “RTV 7403"; General Electric Co.

2.14 FIRE DAMPERS

A. General: U.L. labeled according to U.L. Standard 555 “Standard for Fire Dampers.” Dynamic fire dampers shall be used in systems where the use of the air moving system may be “on” or “off” to control the movement of smoke during a fire. Static fire dampers shall be used in systems where the air moving systems are automatically shut down during the event of fire. All dampers shall bear the UL555 label and be tested in accordance with AMCA Standard 500 for air pressure drop ratings.

B. Manufacturers:

1. Subject to compliance with requirements, provide fire dampers of one of the following:

a. Air Balance, Inc.
b. Ruskin Manufacturing.
c. Greenheck.
d. United Enertech.

2. Model numbers and features listed below are based on Ruskin Manufacturing.

C. Static Type Fire Dampers: <<Use these fire dampers ONLY in static applications where there is NO air flow during a fire event>>:

1. Fire Rating: 1½ hour, curtain with 80-90% free area, or multi-blade type when applicable.

   a. Blades must be out of airstream
2. Blade/Frame: Galvanized or Stainless Steel to match adjoining ductwork. Gauge thickness per UL Listing. Sleeve may be omitted if wall thickness matches damper construction per UL 555.
3. Closure springs: 301 stainless steel (horizontal only) constant force as required by UL listing.
4. Mounting: Horizontal or vertical (floor or wall).
5. Replaceable Fusible Link: 165°F (standard) or 212°F.
6. Selection based on Ruskin Model IBD2 and FD series, or FDR25 (true round type).
7. Factory provided damper/sleeve assembly shall be provided with single side (FAST) or 2-side (PFMA) mounting angles, per manufacturer's requirement for duct size and fire rating. Duct/sleeve breakaway connections are per SMACNA Fire Smoke Installation Guide and/or damper manufactures installation instructions.

D. Dynamic Type Fire Damper:

1. Fire Rating: 1½ hour, curtain type with 80-90% free area or multi-blade type when applicable.

   a. Blades must be out of airstream
2. Blade/Frame: Galvanized or Stainless Steel to match adjoining ductwork. Gauge thickness per UL Listing. Sleeve may be omitted if wall thickness matches damper construction per UL 555.
3. Closure springs: 301 stainless steel constant force or spring clip type as required by UL listing.
4. Mounting: Horizontal or vertical (floor or wall).
5. Replaceable Fusible Link: 165°F (standard), 212°F or 285°F
6. Selection based on Ruskin Model DIBD2 and DFD series, or FDR25 (true round type).
7. Factory provided damper/sleeve assembly shall be provided with single side (FAST) or 2-side (PFMA) mounting angles per manufacturer's requirement for duct size and fire rating. Duct/sleeve breakaway connections are per SMACNA Fire Smoke Installation Guide and/or damper manufactures installation instructions.

2.15 LOUVERS

A. General:

1. Louvers shall be provided under this division and installed under another division.
2. All louvers shall be by the same manufacturer.
3. Louvers shall be AMCA 511 rated and carry this seal.
4. Louvers shall always be caulked, whether they are provided under Architectural Division or provided under Division 23.

B. Manufacturer:

1. Subject to compliance with requirements, provide louvers of one of the following:

    a. Ruskin Corporation.
    b. American Air Warming and Ventilating, Inc.
    c. Greenheck Fan Corporation.
    d. Penn Ventilation Company.
2. Model numbers and features listed below are based on Ruskin model number ELF 675 DX.

C. Louvers are subject to the following:

1. Performance: High performance with 57% free area with free area velocity of not more than 700 fpm. Louver shall be drainable style.
2. Frame: 4" deep, 6063-T5, .0.80" thick extruded aluminum.
3. Blades: 6063-T5, .0.80" thick extruded aluminum.
4. Blade angle: 37.5 degrees.
5. Function: Stationary.
6. Accessories: Birdscreen
7. Finish: Kynar 500
8. Color: The standard color chart shall be submitted for selection by the Architect or Owner.

2.16 LOUVER BLANK-OFF PANELS

A. Provide blank off panels over unused portions of exterior louvers. Blank off panels shall be 1" air enterprises, Inc. Panel shall be caulked and sealed and shall be attached to aluminum angle frames to provide a neat weathertight enclosure. Paint panels per Architect’s directive.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section: “Execution and Closeout Requirements”: Requirements for installation examination.

B. Verify sizes of equipment connections before fabricating transitions.

C. Verify rated walls are ready for fire damper installation.

D. Verify ducts and equipment installations are ready for accessories.

E. Verify ductwork is ready for air terminal installation.

F. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement

3.2 PREPARATION

A. Division 01 Section: “Execution and Closeout Requirements:: Requirements for installation preparation.

B. Obtain manufacturer's inspection and acceptance of fabrication and installation at beginning of installation.

C. Install temporary closures of metal or taped PE on open ductwork to prevent construction dust from entering ductwork system.

3.3 PROTECTION

A. Protect work, material and equipment from weather and construction operations before and after installation.

B. Properly store and handle all materials and equipment.

C. Cover temporary openings in piping, ductwork and equipment to prevent the entrance of water, dirt, debris, and other foreign matter.

D. Ducts with internal duct liner shall be continuously protected from fabrication, transport to the job site, temporary storage, and during installation such that no water, dirt, debris, and other foreign matter is introduced to the liner.

3.4 DUCT INSTALLATION, GENERAL

A. Metal Ducts: Install in accordance with SMACNA 1966 Duct Construction Standards – metal and flexible.

B. Glass-Fiber-Reinforced Ducts: Comply with SMACNA 1884.

C. Insulated Flexible Duct Fittings:

1. Join each flexible duct section to main trunk duct through sheet metal fittings.
2. Material: Galvanized steel.
3. Equip fittings with factory-installed volume damper having positive locking regulator.
4. Provide insulation guard with fittings installed in lined ductwork.

D. Duct System Pressure Class: Construct and install each duct system for the specific duct pressure classification indicated.

E. Install ducts with the fewest possible joints.

F. Install louvers and accessories complete with mounting frames as indicated on the drawings. Coordinate all rough opening requirements with all trades prior to fabrication or procurement of any penetrations.

G. Make all penetrations in exterior walls watertight and weatherproof in accordance with manufacturer’s specific installations instructions.

H. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.

I. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.

J. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct useable space or block access for servicing building and its equipment.

K. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

L. Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.

M. Install insulated ducts with 1-inch clearance outside of insulation.

N. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.

O. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

P. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

Q. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-½ inches.

R. Seam and Joint Sealing:

1. General: Seal duct seams and joints as follows:

   a. Seal all transverse joints, longitudinal seams, and duct penetrations.
2. Seal externally insulated ducts prior to insulation installation.

S. Connections:

1. General: Installation specified is for conventional connections not exposed to the weather, high heat, or corrosive agents.
2. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 23 Section: “HVAC Distribution.”
3. Branch Connections: Comply with SMACNA “HVAC Air Duct Construction Standards,” Figures 2-7 and 2-8.
4. Outlet and Inlet Connections: Comply with SMACNA “HVAC Duct Construction Standards,” Figures 2-16 through 2-18.
5. Terminal Units Connections: Comply with SMACNA “HVAC Duct Construction Standards,” Figure 2-19.

6. Thermometers and controllers: Cut openings in ductwork to accommodate thermometers and controllers. Cut pitot tube openings for testing of systems, complete with metal can with spring device or screw to eliminate against air leakage.

T. Adjusting and Cleaning:

1. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Division 23 Section: “TESTING, ADJUSTING, AND BALANCING for HVAC” for requirements and procedures for adjusting and balancing air systems.
2. Vacuum duct systems prior to final acceptance to remove dust and debris.
3. During construction install temporary closures of metal or taped polyethylene on open ductwork to prevent dust from entering ductwork system.

U. Duct Liner Application

1. Adhere insulation with 90% adhesive coverage with mechanical pin fasteners.
2. Secure insulation with mechanical liner fasteners. Comply with SMACNA Standards for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.
6. Follow liner manufacturer’s installation instructions.

V. Installation of Flexible Duct Elbow Supports

1. Install flexible duct elbow supports in accordance with manufacturer’s instructions.
2. Install flexible duct elbow supports over outer jacket of flexible ducts to form smooth, 90-degree ends to eliminate flexible duct kinks and airflow restrictions.
3. Make bends in flexible ducts with minimum of 1-duct diameter centerline radius.
4. Install flexible duct elbow supports at flexible duct 90-degr bends at following locations:

    a. Diffusers.
    b. Grilles.
    c. Registers.
    d. Air devices with round inlets and outlets.
    e. HVAC equipment with round inlets and outlets.
    f. Flexible ducts used as elbows.
    g. As indicated on the Drawings.

3.5 LEAK TESTING AIR DISTRIBUTION AND DUCT SYSTEMS

A. Duct Leak Testing:

1. Test the entire ductwork air distribution system.
2. Disassemble, reassemble, and seal segments of systems to accommodate leak testing and for compliance and test requirements.
3. Prior to installing insulation, conduct tests in accordance with SMACNA HVAC air duct leakage testing procedures of reach section of the system. If pressure classifications are not indicated, test entire system at the maximum system operating pressure. Do not pressurize systems above the maximum design operating pressure.

4. Determine leakage from entire system or from each section of the system being tested by relating leakage to the surface area of the test section.
5. Maximum Allowable Leakage: As described in SMACNA HVAC Air Duct Leakage Test Manual “latest edition”. Comply with requirements for leakage listed in Division 23 Section: “Air Distribution” – Duct Applications and Sealing.
6. Remake leaking joints as required and apply sealants to achieve specified maximum allowable leakage.
7. Record leakage testing results on forms from the SMACNA HVAC Air Duct Leakage Test Manual, “latest edition”. Submit results within one week of testing.

3.6 FIRESTOPPING

A. All fire stopping shall be applied in accordance with manufacturers published data and in compliance with UL systems application requirements.

B. Firestopping shall not be applied until all sleeves are permanently secured in place and ductwork successfully tested air tight.

C. Application of firestopping shall be in accordance standard UL directory details, provided by the manufacturer, for the specified wall type as shown on the drawings. Each individual detail of the UL system shall be application specific for duct size, duct construction, insulation application, wall construction and wall rating as indicated by the drawings or specifications.

3.7 HANGERS AND SUPPORTS

A. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in SMACNA “HVAC Duct Construction Standards,” Tables 5-1 through 5-4 and Figures 5-1 through 5-11.

B. Fabricate and support ducts according to SMACNA 1884 and 1966.

C. Threaded Rods: Provide double nuts and lock washers.

D. Building Attachments:

1. Provide concrete inserts or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
2. If possible, install concrete inserts before placing concrete.
3. Powder-Actuated Concrete Fasteners:

    a. Use only for slabs more than 4 inches thick.
    b. Install after concrete is placed and completely cured.
    c. Do not use powder-actuated concrete fasteners for seismic restraints.

E. Hanger Spacing:

1. Comply with SMACNA 1884 and 1966.
2. Install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
3. Extend strap supports down both sides of ducts and turn under bottom at least 1 inch.

4. Secure hanger to sides and bottom of ducts with sheet metal screws.

F. Hangers Exposed to View: Provide threaded rod and angle or channel supports.

G. Vertical Ducts:

1. Support with steel angles or channel secured to sides of duct with welds, bolts, sheet metal screws, or blind rivets.
2. Support at each floor and at maximum intervals of 16 feet.

H. Upper Attachments:

1. Attach to structures.
2. Selection and Sizing: Provide pull-out, tension, and shear capacities as required for supported loads and building materials.

I. Penetrations:

1. Avoid penetrations of ducts with hanger rods.
2. If unavoidable, provide airtight rubber grommets at penetrations.

3.8 AIR DEVICE INLETS AND OUTLETS

A. Inspection:

1. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Installation:

1. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.
2. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work including, but not limited to; sprinkler heads, exit signs, lights, speaker systems, electrical pullbox access, architectural features and ceiling support system.
3. Locate ceiling air diffusers, registers, and grilles, as indicated on the contract drawings. Unless otherwise indicated, locate air device units in center of acoustical ceiling modules or between plaster framing supports/framing in hard ceiling construction.
4. Paint ductwork visible behind air outlets matte black in accordance with Division 09 Section: "Paints and Coatings."
5. Insulate the backs of supply diffusers and tape all around insulation seems.

C. Spare Parts:

1. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.
2. Operating keys shall be tagged similar to piping valve tags and labeled in the Owner's operating and maintenance manual.

3.9 AIR TERMINAL UNIT INSTALLATION

A. Connect to ductwork

B. Install ceiling access doors or locate units above easily removable ceiling components.

C. Support units individually from structure. Do not support from adjacent ductwork.

D. Support air terminal units connected by flexible duct independently of flexible duct.

E. Install transition piece to match flexible duct size to inlet or outlet of variable air volume terminal.

F. Install minimum of 6 ft of 1 inch thick lined ductwork downstream of units.

3.10 DAMPERS, GENERAL:

A. Provide access to damper components for maintenance of linkage, adjustments and visual inspection.

B. All dampers shall be installed with their flange outside of the airstream.

C. Coordinate access to damper with all trades.

D. Coordinate motor operated damper requirements with Division 23 Section: “Instrumentation and Control for HVAC.”

E. Fire dampers shall be installed per manufacturer’s U.L. approved printed installation instructions. Provide access panels for fusible links with a minimum size requirement of 12" x 16" inside clear or as required by the Engineer to successfully reach the fusible link assembly for replacement.

F. Install volume control dampers in lined duct with methods to avoid damage to liner and to avoid erosion of duct liner material.

G. Make all adjustments to dampers for proper operation. Backdraft dampers shall be set by the Balancing Contractor upon final system adjustment.

H. Install balancing dampers on duct take-off to diffusers and grilles and registers, regardless of whether dampers are specified as part of diffuser, or grille and register assembly.

I. Test and inspect fire and fire dampers after the first year of installed service, per NFPA 80 and NFPA 105 requirements.

J. Furnish and install ceiling radiation dampers at all penetrations of the UL listed ceiling assembly. These locations include, but are not limited to, air device locations, duct penetrations, and equipment locations. Refer to detail-typical UL floor/ceiling/roof rated assembly penetrations for more information.

3.11 DUCT MOUNTED ACCESS DOORS:

A. Install duct mounted access doors at the following locations, and as shown on the contract drawings:

1. Spaced every 50 feet of straight duct.
2. Upstream of each re-heat coil.
3. Before and after each duct mounted coil.
4. Before and after each duct mounted fan.
5. Before and after each automatic control damper.
6. Before and after each fire damper

B. Duct access doors shall be installed centered in the width of the horizontal dimension or vertical dimension taking advantage of the most accessible installation for maintenance.

C. Access doors shall not be covered with insulation.

D. Install doors prior to performance of ductwork leak testing.

3.12 TERMINAL HEATING UNITS, GENERAL:

A. Inspection - Examine all areas and conditions under which Terminal Reheat Units are to be installed. Do not proceed with work in questionable areas until conditions have been corrected in a manner acceptable to meet installation requirements.

B. Installation of Terminals:

1. General: Install Terminal Reheat Units as indicated and in accordance with manufacturer’s printed installation instructions.
2. Locate each unit level and accurately in position indicated in relation to other work. Maintain sufficient clearance around operating parts for maintenance. Control panels shall have a minimum of 36" unobstructed space for controller access, but in no case less space than recommended by the manufacturer.
3. Fan powered terminal units shall be installed to allow removal of the unit bottom providing full access to the unit. This access shall not be subject to removal of light fixtures or ceiling air devices, etc.
4. Duct inlet connections to air terminals shall be in accordance with manufacturer’s recommendations for straight length of duct and diameter required for maximum controller performance. Reductions to inlets are not permitted.
5. Coordinate units with reheat coils to locate the heating coil control valve and terminal unit control box are on the same side. (This applies to electric and hydronic heating coils.)
6. Transition ductwork from terminal unit with soundlining as detailed on the contract drawings or as recommended by the manufacturer to deaden sound transmission.
7. Install fan powered terminal units with vibration isolation.
8. Demonstrate that all air terminal units and duct connections are leak tight prior to operation. Repair or replace any damaged units prior to system operation and retest for compliance.
9. Insulate terminal units to avoid condensation at duct connections and on hydronic heating coil to minimize heat loss. Refer to Division 23 Section: **“**HVAC Insulation”.
10. Label all terminal units in accordance with Division 23 Section: “Identification for HVAC Piping and Equipment” and clearly position identification for unit within plain sight.

C. Cleaning: Clean all factory exposed surfaces, inside and out prior to operation. Repair any marred surfaces with manufacturer's touch-up paint to match factory finish in color and texture.

3.13 SYSTEM START UP

A. System start-up shall be provided by a factory-authorized representative of the manufacturer.

B. The balancing contractor shall be responsible for final verification and reporting of all airflows.

3.14 CLOSEOUT ACTIVITIES

A. Training

1. The LACS supplier shall furnish a minimum of eight hours of owner training by factory trained and certified personnel. The training will provide an overview of the job specific airflow control components, general procedures for verifying airflows of air valves and general troubleshooting procedures.
2. Operation and maintenance manuals, including as-built wiring diagrams and component lists, shall be provided for each training attendee.

3.15 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section "Commissioning".

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable

END OF SECTION

SECTION 23 34 00
HVAC FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specifications, apply to this section, and other sections of Division 23.

1.2 SUMMARY

A. Section Includes:

1. Inline ceiling fans.
2. Centrifugal square inline cabinet fans.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 07 Section: “Roof Accessories”. Product and Execution requirements for roof curbs etc…
2. Division 23 Section: “Common Motor Requirements”: Product requirements for motors for placement by this section.
3. Division 23 Section: “Vibration and Seismic Controls for HVAC Piping and Equipment”: Product requirements for resilient mountings and snubbers for fans for placement by this section.
4. Division 23 Section: “HVAC Insulation”: Product requirements for power ventilators for placement by this section.
5. Division 23 Section: “HVAC Air Distribution.”
6. Division 23 Section: “Instrumentation and Control for HVAC”: Product requirements for control components to interface with fans.
7. Division 26 Section: “Low Voltage Electrical Power Conductors and Cables:” Requirements for electrical wiring and cable connections for units specified in this section.
8. Division 26 Section: “Raceways and Boxes for Electrical Systems:” Requirements for electrical conduits and boxes housing electrical wiring and connections specified by this section.

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”)

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. Air Movement and Control Association International, Inc.:

1. AMCA 99 - Standards Handbook.
2. AMCA 200 - Publication, Air Systems
3. AMCA 201-90 - Publication, Fans and Systems
4. AMCA 202-88 - Publication, Troubleshooting
5. AMCA 203-90 - Publication, Field Performance Measurement of Fan Systems
6. AMCA 204 - Balance Quality and Vibration Levels for Fans.
7. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
8. AMCA 211-05 - Publication, Certified Ratings Program – Product Rating Manual for Fan Air Performance
9. AMCA 260 - Laboratory Methods for Testing Induced Flow Fans for Rating.
10. AMCA 300 - 96 - Reverberant Room Method for Sound Testing of Fans.
11. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
12. AMCA 311-05 - Publication Certified Ratings Program – Product Rating Manual for Fan Sound Performance
13. AMCA 99-2408-69 - Operating Limits for Centrifugal Fans

C. Air Movement and Control Association Inc. (AMCA), American National Standards Institute (ANSI):

1. 204-05 - Standard Balance Quality and Vibration Levels for Fans
2. 210-99 - Standard Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

D. American National Standards Institute (ANSI):

E. 11-r1999 - Method of Evaluating Load Ratings of Bearings

F. American Refrigeration Institute:

1. ARI 1060 - Air-to-Air Energy Recovery Ventilation Equipment Certification Equipment Program.

G. American Society of Civil Engineers (ASCE):

1. 7-02 - Minimum Design Loads for Building and Other Structures

H. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):

1. Chapter 45 - 2003 Handbook, HVAC Applications
2. Chapter 7 - 2001 Fundamentals Handbook, Sound-Vibration
3. Chapter 32 - 2001 Fundamentals Handbook, Duct Design
4. Chapter 18 - 1992 HVAC System and Equipment Handbook, Fans

I. American Society for Testing and Materials (ASTM):

1. E330-02 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylight and Curtain Walls by Uniform Static Air Pressure Difference

J. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generators.
2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

K. National Fire Protection Association (NFPA)

1. 70 - National Electrical Code
2. 90A-02 - Standard for the Installation of Air-Conditioning and Ventilating Systems
3. 92A-06 - Recommend Practice for Smoke-Control System
4. 92B-05 - Standard for Smoke Management System in Malls, Atria, and Large Areas
5. 96-04 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

L. Occupational Safety and Health Administration (OSHA):

1. 1910.212 - General requirements for Machine Guarding
2. 1910.219 - General requirements for guarding safe use of mechanical power transmission apparatus
3. 1926.300 - General requirements for safe operation and maintenance of hand and power tools

M. Underwriters Laboratories Inc.:

1. UL 507 - Electric Fans.
2. UL 555 - Fire Dampers.
3. UL 705 - Power Ventilators.

1.4 SUBMITTALS

A. Division 01 Section – “Submittal Procedures”: Submittal Procedures.

B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, and ductwork and accessory connections.

C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Submit Manufacturer’s installation, operations, and maintenance manual, including instructions on installation, operations, maintenance, pulley adjustment, receiving, handling, storage, safety information and cleaning. A troubleshooting guide, parts list, warranty and electrical wiring diagrams.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

F. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.5 CLOSEOUT SUBMITTALS

A. Division 01 Section – “Execution and Closeout Requirements”: Closeout Procedures.

B. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.6 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA standard 211 and 311. Fans must be tested in accordance with ANSI/AMCA Standard 210-99 and AMCA Standard 300-96 in an AMCA accredited laboratory. Fans shall be certified to bear the AMCA label for air performance seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

D. Balance Quality: Conform to AMCA 204.

E. Comply with the National Electrical Manufacturers Association (NEMA), standards for motors and electrical accessories.

F. The Finite Element Analysis (FEA) is the results from the CFD and it can accurately predict the stress, strain, and deflection resulting from high wind loads.

G. Energy Recovery Unit Wheel Energy Transfer Rating: Meet ARI 1060.

H. Perform Work in accordance with all applicable codes, standards and local authorities having jurisdiction requirements.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section – “Product Requirements”: Product Storage and Handling requirements.

B. Accept fans and components on site in factory protective containers, with factory shipping skids and lifting lugs, inspect for damage.

C. Protect motors, shafts, and bearings from weather and construction dust.

D. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer, material, products included, and location of installation.

E. Storage: Store materials in a dry area indoor, protected from damage, and in accordance with manufacturer's instructions. For long term storage follow manufacturer's Installation, Operations, and Maintenance Manual.

F. Handling: Handle and lift fans in accordance with the manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage. Follow all safety warnings posted by the manufacturer.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

A. Division 01 Section – "Execution and Closeout Requirements": Product Warranties and Product Bonds.

B. Furnish two-year manufacturer's warranty for fans.

C. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

1. The warranty of this equipment is to be free from defects in material and workmanship for a period of two years from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at the Manufacturers option when returned to Manufacturer, transportation prepaid.
2. Motor Warranty is warranted by the motor manufacturer for a period of two years. Should motors furnished by us prove defective during this period, they should be returned to the nearest authorized motor service station.

1.12 MAINTENANCE SERVICE

A. Refer to Manufacturer's Installation, Operation and Maintenance Manual (IOM), to find maintenance procedures.

B. Division 01 Section – "Execution and Closeout Requirements": Requirements for Maintenance Service.

C. Furnish service and maintenance of fans for one year from Date of Substantial Completion.

D. Examine each fan's components, per fan manufacturer's recommendations. Clean, adjust, and lubricate equipment.

E. Include systematic examination, adjustment, and lubrication of fans, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.

F. Perform work without removing fans from service during building normal occupied hours.

G. Provide emergency call back service at all hours for this maintenance period.

H. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.

I. Perform maintenance work using competent and qualified personnel under supervision of manufacturer or original installer.

J. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

1.13 EXTRA MATERIALS

A. Division 01 Section – “Execution and Closeout Requirements”: Spare Parts and Maintenance Materials.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL SQUARE INLINE CABINET FANS

A. Direct Driven Backward Inclined Inline Fans:

1. Manufacturer:

   a. Fans shall meet model numbers, types, sizes, capacities, and electrical characteristics as indicated on the contract drawings. Acceptable manufacturers: Acme, Cook, Greenheck (Basis of Design), Penn Ventilator or Twin City Blower Company.

2. General:

   a. Shall have a normal operating temperature of up to 130 Fahrenheit (54.4 Celsius).
   b. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.

3. Wheel:

   a. Shall be non-overloading, backward inclined centrifugal wheel.
   b. Shall be constructed of aluminum.
   c. Shall be statically and dynamically balanced in accordance to AMCA Standard 204-05.

d. The wheel cone and fan inlet shall be matched and shall have precise running tolerances for maximum performance and operating efficiency.
e. Single thickness blades shall be securely riveted or welded to a heavy gauge back plate and wheel cone.

4. Motors:

a. Motor enclosures shall be Open driproof
b. Motors shall be permanently lubricated, sleeve bearing type on sizes 8-12 and ball bearing type on sizes 14-24 to match with the fan load and furnished at the specific voltage and phase.
c. Motor shall be accessible for maintenance.

5. Housing/Cabinet Construction:

a. Construction material: Aluminum.
b. Square design constructed shall be of heavy gauge galvanized steel and shall include square duct mounting collars.
c. Housing and bearing supports shall be constructed of heavy gauge bolted and welded steel construction to prevent vibration and to rigidly support the shaft and bearing assembly.

6. Housing Supports and Drive Frame:

a. Housing supports shall be constructed of structural steel with formed flanges.
b. Drive frame shall be welded steel which supports the motor.

7. Disconnect Switches: <<Select a. if electricals are providing disconnects. >>

a. Disconnect provided under Division 26.
b. Disconnect shall be:
NEMA 1: indoor application no water: factory standard.
c. Shall be wired from fan motor to junction box.

8. Duct Collars:

a. Shall be of square design to provide a large discharge area.

9. Access Panel:

a. Provide two sided access panels, to allow access to all internal components.
b. Locate perpendicular to the motor mounting panel.

10. Accessories:

a. Dampers:
1) Types: Gravity.
2) Provide galvanized frames with prepunched mounting holes.
3) Shall be balanced for minimal resistance to flow.
4) Provide end switch for motorized damper assembly.
b. Finishes:
1) Types: None
c. Inlet and Outlet Guards:
1) Shall be constructed of expanded metal mounted in a steel frame to provide protection for non-ducted installations.
d. Isolation:

1) Refer to Division 23 Section - “Vibration and Seismic Controls for HVAC Piping and Equipment”.

e. Motor Cover:
1) Shall be constructed of galvanized steel.
2) Shall cover motor and drives for safety.
3) Shall be standard on units specified with UL.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section – “Administrative Requirements”: Coordination and project Conditions.

3.2 PREPARATION

A. Ensure that roof openings are square and/or round and accurately aligned, correctly located, and in tolerance.

B. Ensure that ducts are plumb, sized correctly, and to proper elevation above roof decks.

3.3 INSTALLATION

A. Suspended Cabinet Fans: Install flexible connections between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch (25 mm) flex between ductwork and fan while running.

B. Install backdraft dampers on inlet to exhaust fans.

C. Provide backdraft dampers on outlet from cabinet and ceiling fans and as indicated on Drawings.

D. Install safety screen where inlet or outlet is exposed.

E. Install backdraft dampers on the discharges of exhaust fans when they are not integral with fans and as indicated on the Contract Drawings.

F. Provide adjustable sheaves as required for final air balance.

G. Install Work in accordance with all applicable codes, standards, and local authorities having jurisdiction requirements.

H. Install fans in accordance with the fan manufacturer’s instructions and as indicated on the contract drawings.

3.4 MANUFACTURER'S FIELD SERVICES

A. Division 01 Section – “Quality Requirements”: Requirements for Manufacturer’s Field Services..

B. Furnish services of factory trained representative for minimum of day to start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.5 CLEANING

A. Division 01 Section – “Execution and Closeout Requirements”: Requirements for Cleaning.

B. Vacuum clean coils and inside of fan cabinet.

3.6 DEMONSTRATION

A. Division 01 Section – “Execution and Closeout Requirements”: Requirements for Demonstration and Training.

B. Demonstrate fan operation and maintenance procedures.

3.7 PROTECTION OF FINISHED WORK

A. Refer to Division 01 Section: “Execution Requirements”: Requirements for protecting finished Work.

B. Do not operate fans until ductwork is clean, filters are in place, bearings are lubricated, and each fan has been test run under observation.

3.8 ADJUSTING

A. Adjust fans to function properly.

B. Lubricate bearing.

C. Adjust drives for final system balancing.

D. Check wheel overlap.

3.9 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section “Commissioning”.

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable

END OF SECTION

SECTION 23 81 06
PACKAGED ROOFTOP AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specifications, apply to this section, and the other sections of Division 23.

1.2 SUMMARY

A. Section Includes:

1. Packaged rooftop air conditioning unit.
2. Roof curb.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 09 Section: “Roof Accessories”: Related to Roof curbs and Roof curb flashing.
2. Division 23 Section: “Instrumentation and Control for HVAC” for control system remote from unit.
3. Division 23 Section: “Vibration and Seismic Controls for HVAC Piping and Equipment”: Vibration isolators.
4. Division 23 Section: “Pipes and Tubes for HVAC Piping and Equipment”:
5. Division 22 Section: “Pipes and Tubes for Plumbing Piping and Equipment”:
6. Division 23 Section: “HVAC Air Distribution Systems”: Flexible connections.
7. Division 26 Section: “Low voltage Electrical Power Conductors & Cables”: Requirements for electrical wiring and cable connections for units specified in this section.
8. Division 26 Section: “Raceways and Boxes for Electrical Systems:” Requirements for conduits and boxes housing electrical wiring and electric connections specified by this section.”

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”)

A. Air-Conditioning Heating, and Refrigeration Institute:

1. ARI 210/240 – Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
2. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
3. ARI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.

B. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
2. ASHRAE 62 - Ventilation for acceptable Indoor Air Quality.
3. ASHRAE 90.1 - Energy Standard for Buildings except Low-Rise Residential Buildings.

D. ASTM International:

1. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

E. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA MG 1 - Motors and Generators.

F. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

1.4 DEFINITIONS

A. Energy Efficiency Ratio (EER) - Ratio of net cooling capacity in Btuh to total rate of electric input in watts under designated operating conditions.

B. Seasonal Energy Efficiency Ratio (SEER) - Total cooling output of an air conditioner during its normal annual usage period for cooling (in Btu) divided by total electric energy input during the same period (in Wh).

C. Integrated Part-Load Value (IPLV): Single-number figure of merit based on part-load EER, COP, or kW/ton expressing part-load efficiency for air-conditioning and heat pump equipment on basis of weighted operation at various load capacities for the equipment.

D. Integrated energy efficiency ratio (IEER) single number figure of merit expressing cooling part load EER efficiency for commercial unitary air conditioning and heat pump equipment on the basis of weighted operations of various load capacities for the equipment.

1.5 SUBMITTALS

A. Division 01 Section: “Submittal Procedures”: Submittal Procedures.

B. Shop Drawings: Indicate air handling unit dimensions, performance data, lifting points, piping connections, roof curb data, and attachments.

C. Product Data: Submit data indicating:

1. Cooling and heating capacities.
2. Dimensions.
3. Weights.
4. Rough-in connections and connection requirements.

5. Duct connections.
6. Electrical requirements with electrical characteristics and connection requirements.
7. Controls: Provide the following items:

    a. A detailed description of the programmed sequence.
    b. Control interface (BACNet)
    c. List of all available control points (points that can be changed by the central control system remotely).
    d. List of all available monitoring points (points that can be viewed by the central control system remotely).
    e. Provide a description for each point in non-coded language.
    f. Provide the address or name of the point or SNVT (Standard Network Variable Type).
    g. Indicate the read/write capability for each point.
8. Accessories.

D. Test Reports: Submit results of factory test at time of unit shipment.

E. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Blank Pre-functional checklists and start-up forms: Submit these forms to the Commissioning Agent (CxA) prior to conducting any start-ups.

H. Manufacturer’s Field Reports: Submit start-up report and completed pre-functional checklists for each unit.

I. LEED Submittals: Comply with Section 018113.

1. EA Prerequisite 4: Fundamental Refrigerant Management

    a. Documentation for equipment containing refrigerants over one-half (0.5) pound, stating type and quantity of refrigerant.
2. EQ Credit 1 Enhanced Indoor Air Quality Strategies and EQ Credit 3: Construction Indoor Air Quality Management

    a. Filter media installed during construction and prior to occupancy: Indicate MERV rating or filter class.

J. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.6 CLOSEOUT SUBMITTALS

A. Division 01 Section: “Execution and Closeout Requirements”: Closeout Procedures.

B. Project Record Documents: Record actual locations of controls installed remotely from units.

C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.7 QUALITY ASSURANCE

A. Cooling Capacity: Rate in accordance with ARI 210/240 and ARI 340/360.

B. Sound Rating: Measure in accordance with ARI 270.

C. Insulation and adhesives: Meet requirements of NFPA 90A.

D. Performance Requirements: Conform to minimum EER/SEER prescribed by ASHRAE 90.1 when tested in accordance with ARI 210/240 and ARI 340/360.

E. Outside Air Damper Leakage: Test in accordance with AMCA 500.

F. Perform Work in accordance with all applicable codes, standards, and local authorities having jurisdiction requirements.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years' experience.

1.9 PRE-INSTALLATION MEETINGS

A. Division 01 Section: "Administrative Requirements": Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section: "Product Requirements": Product storage and handling requirements.

B. Accept units on site. Inspect for damage.

C. Protect units from damage by storing off roof until roof mounting curbs are in place.

1.11 COORDINATION

A. Division 01 Section: "Administrative Requirements": Requirements for coordination.

B. Coordinate installation of roof curbs with roof structure, roof deck and roof membrane installation.

C. Coordinate all controls with BMS contractor to ensure proper communication between the central control system and the unit as required by the contract documents. Provide a list of all available points (non-coded language description) to the BMS contractor. Ensure RTU can accept all required control points from BMS and that the BMS can read all required monitoring points. Ensure that the controls interface between the packaged RTU controls and the BMS is operational.

D. Coordinate with Engineer regarding control sequence. Any deviation of the programmed controls from the specified controls should be clarified in writing and provided to the Engineer and Commissioning Agent (CxA) for review.

E. Contractor is responsible for providing all control devices shown on the ATC diagram or points list in the contract documents unless otherwise specified. Prior approval by the Engineer is required, in writing, to change this requirement. If there are issues regarding these devices they should be documented in writing and provided to the Engineer (and CxA) for review.

1.12 WARRANTY

A. Division 01 Section: “Execution and Closeout Requirements”: Product warranties and product bonds.

B. Furnish five year manufacturer’s warranty for compressors.

C. Furnish five year manufacturers warranty for heat exchangers.

1.13 MAINTENANCE SERVICE

A. Division 01 Section: “Execution and Closeout Requirements”: Requirements for maintenance service.

B. Furnish service and maintenance of equipment for one year from Date of Substantial Completion. Include maintenance items as shown in manufacturer's operating and maintenance data, including filter replacements, fan belt replacement, and controls checkout and adjustments.

C. Examine unit components monthly. Clean, adjust, and lubricate equipment.

D. Include systematic examination, adjustment, and lubrication of unit, including filter replacements, fan belt replacement, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.

E. Perform work without removing units from service during building normal occupied hours.

F. Furnish 24-hour emergency service on breakdowns and malfunctions for this maintenance period.

G. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.

H. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer.

I. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

1.14 EXTRA MATERIALS

A. Division 01 Section: “Execution and Closeout Requirements”: Spare parts and maintenance products.

B. Furnish one set of fan belts for each unit.

C. Furnish one set of filters for each unit.

PART 2 - PRODUCTS

2.1 DOAS UNIT (DOAS-1)

A. General: The units shall be down discharge airflow. Cooling performance shall be rated in accordance with ARI testing procedures. All units shall be factory assembled, internally wired, fully charged with R-410A, and 100 percent run tested to check cooling operation, fan and blower rotation, and control sequence before leaving the factory. Wiring internal to the unit shall be colored and numbered for simplified identification. Units shall be ETL listed and labeled, classified in accordance to UL 1995/CAN/CSA No. 236-M40 for Central Cooling Air Conditioners. Canadian units shall be CSA Certified.

B. Casing: Unit casing shall be constructed of zinc coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit's surface shall be tested 672 hours in a salt spray test in compliance with ASTM B117. Unit shall have 2 inch thick Antimicrobial polyisocyanurate foam insulation, metal encapsulated with no exposed edges. Initial R value of 6.6 per inch of thickness. The unit's base pan shall have no penetrations within the perimeter of the curb other than the raised downflow supply/return openings to provide an added water integrity precaution, if the condensate drain backs up.

C. Unit Top: The top cover shall be one piece construction or, where seams exist, it shall be double-hemmed and gasket-sealed. The ribbed top adds extra strength and enhances water removal from unit top.

D. Sensors: A factory installed combination outdoor air sensor located in the outdoor air hood is designed to sense both outdoor air temperature and relative humidity for use by the microprocessor controller to make required ventilation, cooling, dehumidification and heating decisions. Refer to the Sequence of Operations section of the Installation, Operation and Maintenance manual for detailed unit control and operational modes. A factory installed sensing tube is designed to sense the supply air temperature downstream of the indoor fan section.

E. Refrigerant and Capacity Control: R-454B – Low GWP Refrigerant & No RCC Valve. Unit shall be fully charged with R-454B. Unit shall be ETL listed and labeled, classified in accordance with UL 60335-2-40/CS C22.2 No. 60335-2-40 for Central Cooling Air Conditioners.

F. Indoor Fans: Supply Fan motor shall be direct drive type with factory installed Variable Frequency Drive. All motors shall be thermally protected. All indoor fan motors meet the U.S. Energy Policy Act of 2005 (EPACT).

G. Evaporator Coil: Internally finned, 5/16 inch copper tubes mechanically bonded to a configured aluminum plate fin shall be standard. Coils shall be leak tested at the factory to ensure the pressure integrity. The evaporator coil shall be leak tested to 500 psig and pressure tested to 500 psig. A Stainless Steel double-sloped condensate drain pan with provision for through the unit wall condensate drain is standard. Evaporator coil will have 4 interlaced rows for superior sensible and latent cooling.

H. Hot Gas Reheat: This option shall consist of a modulating hot-gas reheat coil located on the leaving air side of the evaporator coil pre- piped and circuited with a low pressure switch. Refer to the Sequence of Operations section of the Installation, Operation and Maintenance manual for detailed unit control and operational modes.

I. Compressor: All units shall have direct-drive, hermetic, digital scroll type compressors with centrifugal type oil pumps. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage. Internal overloads shall be provided with the scroll compressors. Crankcase heaters shall be included. Compressor shall be able to fully modulate from 20%-100%.

J. Condenser: (Fin and Tube Coil) - Internally finned, 5/16 inch copper tubes mechanically bonded to a configured aluminum plate fin shall be standard. Coils shall be leak tested at the factory to ensure the pressure integrity. The condenser coil shall be leak tested to 500 psig and pressure tested to 500 psig. The condenser coil shall have a fin design with slight gaps for ease of cleaning.

K. Outdoor Fans: Shall be direct drive vertical discharge design with low-noise corrosion resistant glass reinforced polypropylene props, powder coated wire discharge guards and electro-plated motor mounting brackets. Fans shall be statically and dynamically balanced. Condenser fans to be controlled via VFD to maintain adjustable pressure to increase reheat capacity where applicable and low ambient control.

L. Indoor Blower Motor: Supply Fan motor shall be direct drive type with factory installed Variable Frequency Drive (unless no controls option is selected, VFD can be provided by others). All motors shall be thermally protected. All indoor fan motors meet the All indoor fan motors meet the U.S. Energy Policy Act of 2005 (EPACT). All Fans shall be mounted on rubber vibration isolators, to reduce the transmission of noise.

M. Electric Heater: Primary heat is supplied using Electric Resistance heaters. Heaters shall meet the requirements of the National Electrical Code and shall be listed by Underwriters Laboratories for zero clearance to combustible surfaces and for use with heat pumps and air conditioning equipment. Heating elements shall be open coil, 80% nickel, 20% chromium, Type A resistance wire, Type C alloys containing iron or other alloys are not acceptable. Coils shall be machine crimped into stainless steel terminals extending at least 1" into the air stream and all terminal hardware shall be stainless steel. Coils shall be supported by ceramic bushings staked into supporting brackets. Brackets are not to be spaced more than 4-1/2" apart. Heater frames and terminal boxes shall be corrosion resistant steel. Unless otherwise indicated, the terminal box shall be NEMA 1 construction and shall be provided with a hinged, latching cover. Open coil heaters shall be furnished with an airflow switch, disconnecting contactors, fuses (if over 48 amps), control circuit transformer (with primary fusing on Class I circuits as required), built-in, snap acting, door interlock disconnect switch, and a disk type, automatic reset thermal cutout for primary overtemperature protection. Heaters shall also be furnished with disk type, load-carrying

manual reset thermal cutouts, factory wired in series with heater stages for secondary protection. Heat limiters or other fusible overtemperature devices are not acceptable. For modulating heaters, control will be SCR type. For staged heaters, 5kW capacity will be 2 stage and all heaters above 5kW will be 4 stage. Unit shall be suitable for use with Electric Resistance Heat.

N. Controls: Unit is completely factory wired with necessary controls and contactor pressure lugs for power wiring. Units will provide an external location for mounting fused disconnect device. PLC controls are provided for all 24 volt control functions. The resident control algorithms will make all heating, cooling and/or ventilating decisions in response to electronic signals from sensors measuring outdoor temperature and humidity. The control algorithm maintains accurate temperature control, minimizes drift from set point and provides better building comfort. A centralized PLC (UC600) will provide anti-short cycle timing for a higher level of machine protection. Terminals are provided for a field installed dry contact or switch closure to put the unit in the Occupied or Unoccupied modes.

O. Powered Exhaust: Powered Exhaust Fan motor shall be direct drive type with factory installed Variable Frequency Drive to(unless no controls option is selected and the VFD is to be provided by others) allow variable air volume operation. All motors shall be thermally protected. All fan motors shall meet the U.S. Energy Policy Act of 2005 (EPACT). All Fan(s) shall be mounted on rubber vibration isolators, to reduce the transmission of noise.

P. Energy Recovery: Energy recovery wheel performance shall be AHRI 1060 certified and bear the AHRI certified label. The rotating wheel heat exchanger is composed of a rotating cylinder in an insulated cassette frame complete with removable energy transfer media, seals, drive motor and drive belt. Energy transfer media shall be constructed of a durable synthetic lightweight polymer. The total energy recovery wheel is coated with a desiccant tat shall be either Type-A silica gel or 3A molecular sieve and permanently bonded to the energy transfer media without the use of binders or adhesives. The lightweight polymer substrate will not degrade nor require additional coatings for application in marine or coastal environments. Coated segments are cleanable outside of the cabinet with detergent or alkaline coil cleaner and water. Desiccant will not dissolve nor deliquesce in the presence of water or high humidity.

Q. Outdoor Air Damper: The unit shall have a factory installed and integrated 100% outdoor air hood with damper controlled a by direct coupled actuator and 2 inch permanent and washable aluminum mesh filters accessible through a hinged access panel. The return air damper tray is blocked off to allow 100% outdoor airflow.

R. Filters: Filter media installed during construction: Minimum MERV 8 (or Class F5). Filter media installed prior to occupancy: Minimum MERV 13 (or Class F7).

S. Electrical: A 3-pole, molded case, HACR circuit breaker with provisions for through the base electrical connections shall be factory installed. Wiring will be provided from the circuit breaker to the unit high voltage terminal block. The switch will be UL/CSA agency recognized. The circuit breaker will be sized per NEC and UL guidelines. Factory wired Voltage/Phase monitor shall be included as standard. In the event of any of the following, the units will be shut down and upon correction of the fault condition the unit will reset and restart automatically. Phase Unbalance Protection: Factory set 2%. Over/Under/Brown Out Voltage Protection: +/-10% of nameplate voltage.

T. Air Flow Monitoring: Outdoor Air w/ Display and IFM w/ Piezo Ring/Tap. The Greentrol GF-2100-A and GF-2200-A are high quality economical programmable dual-output airflow/temperature measurement and control instruments with options for analog air flow, temperature,and alarm. It is designed for installation in specified critical applications that require precise measurement of

air flow (down to zero flow). The instrument includes factory calibrated probes and an advanced microprocessor-controlled transmitter/controller. Each sensor probe is equipped with a high reliability bead-in-glass heated thermistor element, factory calibrated to NIST traceable standards from zero flow to 2,000 FPM. The transmitter is fully independent of the probe and does not require field matching to the probe. An advanced microprocessor processes the raw probe signals and provides versatile programmable airflow measurement and alarm options with direct LED drive or N.O./N.C. relay dry contacts, and selectable analog output signal options. A powerful variable input signal integration option can be engaged to reduce the effects of transient input signal variations, and an innovative Field Calibration Wizard allows for simple, automated field adjustment of the instrument if required. A 16 character LCD display indicates airflow, temperature, system status and is also used for configuration and diagnostics. Field configuration is accomplished using a simple four-button user interface.

2.2 Curbs

A. The work consists of furnishing a HUSHCORE™ *Plus*™ System Model HIC-DS-52 for Rooftop units as described in this specification.

B. Curbs shall to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit.

C. Solid bottom curb shall be factory assembled and fully lined with 1 inch neoprene coated fiberglass insulation and include a wood nailer strip.

D. Manufacturers

1. Basis of Design shall be BRD Noise and Vibration Control
2. Alternate manufacturers shall be submitted for review.

E. Materials

1. HUSHCORE™ *Plus*™ System Model HIC-DS-52 shall consist of a HUSHCORE™ HUSH CURB™ model HIC-2 Seismic/Vibration Curb and a HUSHCORE™ model DS-52 In-Curb Acoustical Treatment System.
2. HUSHCORE™ *Base*™ System Model HIC-2 Seismic/Vibration Curbs where indicated

    a. HUSH MOUNT™ model HIC-2 for 2” static deflection
    b. The structural steel spring isolation curbs shall bear directly on the roof support structure and be flashed and waterproofed into the roof’s membrane waterproofing system.
        1) The curb shall be capable of being re-flashed without lifting the unit.
    c. Equipment manufacturer’s or field fabricated curbs shall not be used.
    d. Curb sides and ends shall be manufactured from minimum 14 ga. G90 galvanized sheet metal (expanded metal or painted steel is not acceptable), reinforced and cross braced as required.
    e. All springs shall provide a minimum of 85% vibration isolation efficiency
        1) All springs shall be adjustable for leveling.
        2) Spring assemblies shall contain restraints and snubbers to resist wind and seismic forces.

f. Spring static deflection and seismic performance criteria shall be as shown or indicated on the drawings, schedules or in the vibration control specification.
g. The curb shall accept standard 2” roof insulation supplied and installed by the roofing contractor
h. A resilient weather seal shall be incorporated into the curb design between the isolated top frame and the base curb assembly.
i. Wood nailer and flashing shall be provided and curbs shall be manufactured to NRCA standards.
j. Curb height shall be 24” high minimum or as shown on the drawings.
k. Curbs shall be shipped pre-assembled. Knocked down kits are not acceptable.
l. All non-galvanized materials shall be prime paint finished.
m. All duct supports, bracing, flashing and safing as required.
n. Unless otherwise recommended by the RTU manufacturer, all curbs shall be full perimeter type. Curbs with condenser pedestal rails are unacceptable.

3. In-Curb Composite Acoustical Treatment

a. HUSHCORE™ DS-52 acoustical composite
b. The overall installed thickness shall have an installed thickness of 8” for the DS-52 composite
c. Shall have a thermal value of R-27
d. Shall meet Class “A” per ASTM E84 for flammability
e. The composite panels shall get HUSH SEALANT™ model HSAC-100 acoustical grade caulk at seams and all perimeter edges inside the curb
f. Shall have 65% post-consumer recycled content
g. Seams for each layer shall be staggered

4. Decking

a. Decking shall be maintained inside the RTU roof curb to a clearance of ¼” maximum around all duct drops but never contact the duct.
b. Pack all air gaps around duct drops for return and supply with HUSH BATT™ and seal with HUSH SEALANT™ HSAC-100.

5. Inspections

a. The manufacturer or their local authorized agent shall inspect the in-curb deck system work on site prior to lowering of the units and issue a letter of certification stating that the products have been properly installed and sealed around all ductwork and drops to eliminate air gaps which can compromise performance.

6. Performance

a. To assure optimized aerodynamic and acoustic performance as well as proper integration and coordination of the final installation, the PLUS™ System shall be supplied by the rooftop unit manufacturer as part of a turnkey package.
b. HUSHCORE™ Model DS-52 In-Curb Composite Acoustical Treatment Performance
1) The combination of all layers shall be tested for Sound Transmission Loss in accordance with procedure ASTM E-90-10. The assembly shall be rated at not less than STC-52 with 1/3 octave performance values as listed below for sound radiation through the deck inside the curb.

Freq. (Hz)	80	100	125	160	200	250	315	400	500	630	800	1K
TL (dB)	26	27	33	32	35	42	45	45	50	56	59	60

Freq. (Hz)	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	STC
TL (dB)	62	63	64	65	67	71	74	78	80	80	52

c. A copy of the test report by an accredited lab shall be included in the submittals to document the above performance

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section: “Administrative Requirements”: Coordination and project conditions.

B. Verify roof curbs are installed and dimensions are as instructed by the manufacturer.

3.2 PREPARATION

A. Furnish roof curbs Refer to Division 07 Sections for additional installation information.

3.3 INSTALLATION

A. Roof Curb:

1. Assemble roof curb.
2. Install roof curb level.
3. Coordinate curb installation and flashing with Division 07 Section: “Roof Accessories”:
4. Install units on roof curb providing watertight enclosure to protect ductwork and utility services.
5. Install gasket material between unit base and roof curb.
6. Unless otherwise indicated, fill all voids between curbs and ductwork with heavy density rigid board insulation of thickness to match height of roof curb.

B. Install units on vibration isolators. Refer to Division 23 Section: “Vibration and Seismic Controls for HVAC Piping and Equipment”.

C. Install flexible connections between unit and inlet and discharge ductwork. Install metal bands of connectors parallel with minimum 3 inch flex between ductwork and fan while running. Refer to Division 23 Section: “HVAC Air Distribution”.

D. Install condensate piping with trap and route from drain pan to splash block on roof or nearest roof drain. Refer to Division 23 Section: “Pipes and Tubes for HVAC Piping and Equipment”.

E. Install components furnished loose for field mounting.

F. Install electrical devices furnished loose for field mounting.

G. Install control wiring between unit and field installed accessories.

H. Remove from roof and dispose off-site panels removed from units during installation of economizer and dampers.

I. Locate remote panels as indicated on the Contract Drawings.

J. Provide adjustable sheaves required for final air balance.

K. Install Work in accordance with all applicable codes, standards, and local authorities having jurisdiction.

L. All wiring within the AHU, where inside a control panel, shall be installed in UL approved conduit or raceway.

3.4 MANUFACTURER'S FIELD SERVICES

A. Division 01 Section: “Quality Requirements”: Requirements for field services.

B. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

C. Provide technical support to ensure the communication interface between the RTU and the BMS is operational.

3.5 CLEANING

A. Division 01 Section: “Execution and Closeout Requirements”: Requirements for cleaning.

B. Vacuum clean coils and inside of cabinets.

C. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.

3.6 DEMONSTRATION

A. Division 01 Section: “Execution and Closeout Requirements”: Requirements for demonstration and training.

B. Engage a factory authorized service representative to train owner’s maintenance personnel to adjust, operate and maintain systems.

1. Train Owner’s maintenance personnel on procedures and schedules for starting up and shutting down, trouble shooting, servicing and maintaining air handling units.
2. Review data in maintenance manuals.
3. Schedule training with owner with at least seven (7) days advance notice.

3.7 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section “Commissioning”.

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable.

END OF SECTION

SECTION 23 81 26
SPLIT SYSTEM AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specifications, apply to this section, and the other sections of Division 23.

1.2 SUMMARY

A. Section Includes:

1. Air handling unit.
2. Condensing unit.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 03 Section: “Cast-In-Place Concrete.” Execution requirement for concrete foundations specified by this section.
2. Division 23 Section: “Common Motor Requirements:” Product requirements for electric motors for placement by this section.
3. Division 23 Section: “Instrumentation and Control for HVAC:” Control systems remote from unit, direct digital controls remote from unit.
4. Division 23 Section: “Vibration and Seismic Controls for HVAC Piping and Equipment:” Vibration isolators.
5. Division 23 Section: “Refrigerant Piping:” Execution requirements for connection to refrigerant piping specified by this section.
6. Division 23 Section: “HVAC Air Distribution:” Flexible connections.
7. Division 23 Section: “Instrumentation and Control for HVAC:” Sequences of operation applying to units in this section.
8. Division 26 Section: “Low Voltage Electrical Power Conductors and Cables:” Requirements for electrical wiring and cable connection for units.
9. Division 26 Section: “Raceways and Boxes for Electrical Systems:” Requirements for conduits and boxes housing electrical wiring and connections specified by this section.”

1.3 REFERENCES

(Unless otherwise noted, references listed below and throughout this specification section apply to “latest editions.”)

A. Air-Conditioning Heating, and Refrigeration Institute:

1. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
2. ARI 270 - Sound Rating of Outdoor Unitary Equipment.

3. ARI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
4. ARI 365 - Commercial and Industrial Unitary Air-Conditioning Condensing Units.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
2. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ASTM International:

1. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

D. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generators.

E. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

1.4 SUBMITTALS

A. Division 01 Section: “Submittal Procedures”: Submittal Procedures.

B. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

C. Product Data: Submit data indicating:

1. Cooling and heating capacities.
2. Dimensions.
3. Weights.
4. Rough-in connections and connection requirements.
5. Duct connections.
6. Electrical requirements with electrical characteristics and connection requirements.
7. Controls.
8. Accessories.

D. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

F. Manufacturer’s Field Reports: Submit start-up report for each unit.

G. LEED Submittals: Comply with Section 018113.

1. EA Prerequisite 4: Fundamental Refrigerant Management

a. Documentation for equipment containing refrigerants over one-half (0.5) pound, stating type and quantity of refrigerant.

2. EQ Credit 1 Enhanced Indoor Air Quality Strategies and EQ Credit 3: Construction Indoor Air Quality Management

a. Filter media installed during construction and prior to occupancy: Indicate MERV rating or filter class.

H. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.5 CLOSEOUT SUBMITTALS

A. Division 01 Section: “Execution and Closeout Requirements”: Closeout Procedures.

B. Project Record Documents: Record actual locations of controls installed remotely from units.

C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.6 QUALITY ASSURANCE

A. Performance Requirements: Conform to minimum, Energy Efficiency Rating (EER) not less than prescribed by ASHRAE 90.1 when used in combination with compressors and evaporator coils when tested in accordance with ARI 210/240

B. Cooling Capacity: Rate in accordance with ARI 210/240

C. Sound Rating: Measure in accordance with ARI 270.

D. Insulation and adhesives: Meet requirements of NFPA 90A.

E. Perform Work in accordance with all applicable codes, standards, and local authorities having jurisdiction requirements.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years’ experience.

1.8 PRE-INSTALLATION MEETINGS

A. Division 01 Section: “Administrative Requirements”: Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section: “Product Requirements”: Requirements for transporting, handling, storing and protecting products.

B. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.

C. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.

D. Protect units from weather and construction traffic by storing in dry, roofed location.

1.10 COORDINATION

A. Division 01 Section: “Administrative Requirements”: Requirements for coordination.

B. Coordinate installation of condensing units with roof structure.

C. Coordinate installation of air handling units with building structure.

1.11 WARRANTY

A. Division 01 Section: “Execution and Closeout Requirements”: Requirements for warranties.

B. Furnish five-year manufacturer’s warranty for compressors.

1.12 MAINTENANCE SERVICE

A. Division 01 Section: “Execution and Closeout Requirements”: Maintenance service.

B. Furnish service and maintenance of equipment for one year from Date of Substantial Completion. Include maintenance items as shown in manufacturer's operating and maintenance data, including filter replacements, fan belt replacement, and controls checkout and adjustments.

C. Furnish 24-hour emergency service on breakdowns and malfunctions for this maintenance period.

1.13 MAINTENANCE MATERIALS

A. Division 01 Section: “Execution and Closeout Requirements”: Requirements for maintenance materials.

PART 2 - PRODUCTS

2.1 DUCTLESS SPLIT SYSTEMS

A. General

1. Both the air cooled condensing unit and the air handling unit shall be by the same manufacturer and shall be AHRI certified.

2. All equipment on the project shall be by the same manufacturer.

B. Outdoor Ductless Split System Air Cooled Condensing Units

1. Manufacturer

a. Outdoor units shall meet model numbers, types, sizes, capacities and electrical characteristics indicated on the contract drawings. Acceptable manufacturers: Daikin, Rheem, Carrier, Mitsubishi, Trane, LG, or York.

2. General

a. The unit shall be fully charged from the factory for 25 feet of piping. The shall be designed to operate at outdoor ambient temperatures as high as 110°F. Cooling capacities shall be AHRI certified. The unit shall be ETL listed for outdoor application.

3. Unit Casing

a. The unit casing shall be constructed of heavy gauge, galvanized steel and painted with a weather-resistant powder paint.

4. Refrigerant Controls

a. Refrigeration system controls shall include condenser fan and compressor relay. High and low pressure controls shall be inherent to the compressor. A suction line multi-function service shall be provided.

5. Compressor

a. The compressor shall have internal over temperature and pressure protection and total dipped hermatic motor windings. It shall also have centrifugal oil pump and low vibration and noise.

6. Condenser Coil

a. The condenser coil shall consist of aluminum finned coils brazed to copper tubing. The coil shall provide air flow resistance and efficient heat transfer. The coil shall be protected by the casing.

7. Low Ambient Cooling

a. The unit shall be capable of operating in cooling down to 0°F.

C. Indoor Ductless Split System Air Handling Units

1. Manufacturer

a. Outdoor units shall meet model numbers, types, sizes, capacities and electrical characteristics indicated on the contract drawings. Acceptable manufacturers: Daikin, Rheem, Carrier, Mitsubishi, Trane, LG, or York.

2. General

a. The high wall mounted type air handler shall be completely factory assembled including coil, condensate drain pan, fan motor, washable filter, air purifying filter and electric controls to be used with remote controller. Unit shall be shipped with a mounting plate. Unit shall be matched with outdoor unit, rated and tested in accordance with AHRI standard. Unit shall be ETL tested.

3. Unit Casing

a. Casing shall be provided with knockouts on the right and left of the unit to facilitate piping and electrical connection on either side of the unit. An electrical service cover shall be provided to permit easy access to the electrical terminal strip.

4. Discharge Airflow and Distribution System

a. Unit shall have auto swing, dual horizontal blades to optimize aperture outlet for vertical airflow and air distribution. Blade shall close automatically when the air conditioner is turned off to minimize dust enter the unit. Five-step preset program on the remote controller shall control the blade angle.

b. Manually adjusted wide-angle louvers shall be provided to adjust the coverage and direction of airflow.

5. Controls

a. Unit shall be controlled remotely by a wall mounted thermostat. Provide thermostat.

6. Remote Controller

a. The unit shall be provided with a wire infrared remote controller with easy reading digital display to start, stop and regulate the air conditioner from a distance.

7. Filters

a. Filter media installed during construction: Minimum MERV 8 (or Class F5).

b. Filter media installed prior to occupancy: Minimum MERV 13 (or Class F7).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section: “Administrative Requirements”: Verification of existing conditions before starting work.

3.2 INSTALLATION – INDOOR DUCTLESS UNIT

A. Install components furnished loose for field mounting.

B. Install connection to electrical power wiring in accordance with Division 26.

C. Unless otherwise indicated install condensate piping with trap and route from drain pan to nearest floor drain Refer to Division 23 Section: “Pipes and Tubes for HVAC Piping and Equipment”.

D. Water-level monitoring devices: On down flow units and all other coils that do not have a secondary drain or provisions to install a secondary or auxiliary drain pan, a water-level monitoring device shall be installed inside the primary drain pan. This device shall shut off the equipment served in the event that the primary drain becomes restricted. Devices installed in the drain line shall not be permitted.

E. Install Work in accordance with all applicable codes, standards, and local authorities having jurisdiction requirements.

F. All wiring within the unit, where inside a control panel, shall be installed in UL approved conduit or raceway.

G. Refrigerant circuit access ports located outdoors shall be fitted with locking-type-tamper-resistance caps.

3.3 INSTALLATION - CONDENSING UNIT

A. Install condensing units on vibration isolators. Refer to Division 23 Section: "Vibration and Seismic Controls for HVAC Piping and Equipment.”

B. Install refrigerant piping from unit to condensing unit. Install refrigerant specialties specified in Division 23 Section: **“**Refrigerant Piping.”

C. Evacuate refrigerant piping and install initial charge of refrigerant.

D. Install electrical devices furnished loose for field mounting.

E. Install control wiring between air handling unit, condensing unit, and field installed accessories.

F. Install connection to electrical power wiring in accordance with Division 26.

G. Install Work in accordance with all applicable codes, standards, and local authorities having jurisdiction.

3.4 MANUFACTURER'S FIELD SERVICES

A. Division 01 Section: “Quality Requirements”: Requirements for manufacturer’s field services.

B. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

3.5 CLEANING

A. Division 01 Section: “Execution and Closeout Requirements”: Requirements for cleaning.

B. Vacuum clean coils and inside of unit cabinet.

C. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.

3.6 DEMONSTRATION

A. Division 01 Section: “Execution and Closeout Requirements”: Requirements for demonstration and training.

B. Demonstrate split system unit operation and maintenance.

C. Demonstrate starting, maintenance, and operation of condensing unit including low ambient temperature operation.

D. Engage a factory authorized service representative to train owner’s maintenance personnel to adjust, operate and maintain systems.

1. Train Owner’s maintenance personnel on procedures and schedules for starting up and shutting down, trouble shooting, servicing and maintaining air handling units.
2. Review data in maintenance manuals. Refer to Division 1 Section: “Contract Closeout Procedures”.
3. Schedule training with owner with at least seven (7) days advance notice.

E. Furnish services of manufacturer's technical representative for one 8 hour day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days’ notice to Architect/Engineer of training date.

3.7 PROTECTION OF FINISHED WORK

A. Division 01 Section**:** “Execution and Closeout Requirements” for requirements for protecting finished work.

B. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

3.8 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section “Commissioning”.

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable

END OF SECTION

SECTION 23 81 29
VARIABLE REFRIGERANT FLOW SPLIT SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including the General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, and the other Sections of Division 23.

1.2 SUMMARY

A. Section includes:

Variable refrigerant Flow Split System Heat Pump Units.

a. Air cooled

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 03 Section: “Cast-In-Place Concrete.” Execution requirement for concrete foundations specified by this section.
2. Division 23 Section: “Common Motor Requirements:” Product requirements for electric motors for placement by this section.
3. Division 23 Section: “Vibration and Seismic Controls for HVAC Piping and Equipment”: Vibration isolators.
4. Division 23 Section: “Mechanical Insulation” – Insulation materials, thickness, jacketing, etc…
5. Division 23 Section: “Pipes and Tubes for HVAC Piping and Equipment”: Water and drain piping connections.
6. Division 23 Section: “Refrigerant Piping”: Piping and appurtenances related to system.
7. Division 23 Section: “Air Distribution Systems”: Flexible connections.
8. Division 23 Section: “Instrumentation and Control for HVAC”:
9. Division 26 Section: “Low voltage Electrical Power Conductors & Cables”: Requirements for electrical wiring and cable connections for units specified in this section.
10. Division 26 Section: **“**“Raceways and Boxes for Electrical Systems”: requirements for conduits and boxes housing electrical wiring and electrical connections specified in this section.

1.3 REFERENCES

(Unless otherwise noted, references listed below and throughout this specification section apply to “latest edition”)

A. Air-Conditioning Heating, and Refrigeration Institute:

1. AHRI 1230

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 62.1 – “Ventilation For Acceptable Indoor Quality”.
2. ASHRAE 15 – “Safety Standard for Refrigeration Systems”.
3. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
4. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ASTM International:

1. ASTM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.

D. American National Standards Institute/Underwriting Laboratories:

1. ANSI/UL 1995 - Heating and Cooling Equipments and bear the Listed Mark.

E. ASCE – 7 – Minimum Design Loads for Buildings and other structures.

F. National Fire Protection Association:

1. NFPA 70 – National Electric Code
2. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilating Systems.

G. Nationally Recognized Testing laboratory NRTL

H. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generators.

I. Underwriters Laboratories Inc:

1. UL-508 - Industrial Control Equipment

1.4 SUBMITTALS

A. Division 01 Section: “Submittal Procedures”: Submittal Procedures.

B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

C. Product Data: Submit data indicating:

1. Cooling and heating capacities.
2. Dimensions.
3. Weights.
4. Rough-in connections and connection requirements.
5. Duct connections.
6. Electrical requirements with electrical characteristics and connection requirements.
7. Controls.
8. Accessories.

D. If basis of design is not submitted or comparable acceptable product is not submitted, the substituted manufacturer shall provide all required design and equipment modifications for a complete and operable system that meets the performance requirements indicated in the contract documents.

1. If a substituted manufacturer's system is provided, the contractor shall be responsible for all revisions to design and construction scope required by all trades including but not limited to piping, ductwork, equipment, controls, electrical power, architectural, and structural support at no additional cost to the owner for the use of alternate manufacturer's system.
2. Contractor shall submit all required revisions caused by the use alternate manufacturer's system for review per Division 01 Section: "Submittal Procedures".

E. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

    a. Installing contractor shall provide coordinated AS-BUILT control wiring drawings.
    b. Control wiring drawings shall detail VRF wiring, thermostat wiring, thermostat locations, and wiring to the BAS.

F. Samples for Initial selection: For units with factory-applied color finishes.

G. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

H. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

I. Manufacturer's Field Reports: Submit start-up report for each unit.

J. Operation and Maintenance Data: For split-system air conditioning units to include in emergency, operation, and maintenance manuals.

K. Warranty: Sample of special warranty.

L. LEED Submittals: Comply with Section 018113.

1. EA Prerequisite 4: Fundamental Refrigerant Management

    a. Documentation for equipment containing refrigerants over one-half (0.5) pound, stating type and quantity of refrigerant.
2. EQ Credit 1 Enhanced Indoor Air Quality Strategies and EQ Credit 3: Construction Indoor Air Quality Management

    a. Filter media installed during construction and prior to occupancy: Indicate MERV rating or filter class.

M. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.5 CLOSEOUT SUBMITTALS

A. Division 01 Section: “Execution and Closeout Requirements”: Closeout Procedures.

B. Project Record Documents: Record actual locations of controls installed remotely from units.

C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.6 QUALITY ASSURANCE

A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL – Heating and Cooling Equipment and bear the Listed Mark.

B. All wiring shall be in accordance with the National Electric Code (NEC).

C. The system shall be produced in an ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.

D. Any approved manufacturer shall be rated and certified in accordance with AHRI standard 1230 and meet minimum efficiencies as scheduled.

E. The approved manufacturer shall have parts, equipment and materials stocked.

F. The approved manufacturer shall have factory trained service technicians available.

G. Mechanical equipment for wind-born debris regions shall be designed in accordance with ASCE 7-2010 and installed to resist the wind pressures on the equipment and the supports.

H. The condensing unit will be factory charged with R410A.

I. Electrical components Devices and Accessories: listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

J. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, “Safety Standards for Refrigeration Systems”.
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1 Section 4 – “Outdoor Air Quality”, Section 5 – “Systems and Equipment”, Section 6 – “Procedures” and Section 7 – “Construction and Startup”.

K. ASHRAE /IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

L. Sound Rating: Measure in accordance with ARI 270.

M. Insulation and adhesives: Meet requirements of NFPA 90A.

N. Perform Work in accordance with all applicable codes, standards, and local authorities having jurisdiction requirements.

1.7 COORDINATION

A. Division 01 Section: “Administrative Requirements”: Requirements for coordination.

B. Coordinate installation of condensing units with roof structure.

C. Coordinate installation of air handling units with building structure.

1.8 WARRANTY

A. Division 01 Section: “Execution and Closeout Requirements”: Product warranties and product bonds.

B. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of spilt-system air-conditioning units that fall in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five years from date of Substantial Completion.
b. For Parts: Two years from date of Substantial Completion.
c. For Labor: Two years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Division 01 Section: “Execution and Closeout Requirements”: Spare parts and maintenance products.

B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set of each air-handling unit.
2. Gaskets: Sets for each access door.
3. Fan Belts: One sets for each air-handling unit fan.

1.10 PRE-INSTALLATION MEETINGS

A. Division 01 Section: “Administrative Requirements”: Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section: “Product Requirements”: Product storage and handling requirements.

B. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.

C. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.

D. Protect units from weather and construction traffic by storing in dry, roofed location.

1.12 INSTALLATION QUALIFICATIONS

A. The system shall be installed by a factory trained contractor/dealer. The bidders shall be required to submit training certification proof with bid documents. The mechanical contractor's installation price shall be based on the systems installation requirements. The mechanical contractor bids with complete knowledge of the HVAC system requirements. Untrained contractors who wish to bid this project must contact the representative for the manufacturer shown on the drawings to arrange training prior to bid day.

B. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

C. Installer: Company specializing in performing Work of this section with minimum three years' experience.

1.13 MAINTENANCE MATERIALS

A. Division 01 Section: "Execution and Closeout Requirements": Requirements for maintenance materials.

1. Furnish one set for each unit of fan belts and filters.

1.14 MAINTENANCE SERVICE

A. Division 01 Section: "Execution and Closeout Requirements": Maintenance service.

B. Furnish service and maintenance of equipment for one year from Date of Substantial Completion. Include maintenance items as shown in manufacturer's operating and maintenance data, including filter replacements, fan belt replacement, and controls checkout and adjustments.

C. Furnish 24-hour emergency service on breakdowns and malfunctions for this maintenance period.

1.15 OPERATING RANGE

A. The operating range in cooling shall be **<<-4°F DB ~ 122°F DB>>.**

B. The operating range in heating shall be **<<0°F DB ~ 77°F DB/-4°F WB- 60°F WB>>.**

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION R2-SERIES (SIMULTANEOUS HEAT/COOL)

Per the equipment schedule, the variable capacity, heat pump heat recovery air conditioning system basis of design is Mitsubishi Electric CITY MULTI VRF (Variable Refrigerant Flow) zoning system(s).

Acceptable alternative manufacturers, assuming compliance with these equipment specifications, are Daikin, Panasonic, and Hitachi. Contractor bidding an alternate manufacturer does so with full knowledge that that manufactures product may not be acceptable or approved and that contractor is responsible for all specified items and intents of this document without further compensation.

Simultaneous heating/cooling (heat recovery) systems shall consist of an outdoor unit, BC (Branch Circuit) Controller (or comparable branch devices), multiple indoor units, and an integral DDC (Direct Digital Controls) system. Each indoor unit or group of indoor units shall be capable of operating in any mode independently of other indoor units or groups. System shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. To ensure owner comfort, each indoor unit or group of indoor units shall be independently controlled and capable of changing mode automatically when zone temperature strays 1.8 degrees F from set point for ten minutes.

No additional branch circuit controllers (or comparable branch devices) than shown on the drawings/schedule may be connected to any one outdoor unit. Contractors proposing alternate systems requiring more branch devices than those included as the basis of design

are responsible for additional piping & electrical costs and are required to identify additional costs &

installation time required of other trades with their bid.

2.2 QUALITY ASSURANCE

1. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.
2. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
3. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
4. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1230.
5. System start-up supervision shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in system configuration and operation. The representative shall provide proof of manufacturer certification indicating successful completion within no more than two (2) years prior to system installation. This certification shall be included as part of the equipment and/or controls submittals.

DELIVERY, STORAGE AND HANDLING

1. Unit shall be stored and handled according to the manufacturer's recommendation.

2.3 Warranty

1. The CITY MULTI units shall be covered by the manufacturer's limited warranty for a period of two (1) year parts and seven (7) year compressor to the original owner from date of installation.
2. Installing contractor shall meet manufacturer requirements to obtain extended manufacturer's limited parts and compressor warranty for a period of ten (10) years to the original owner from date of installation. This warranty shall not include labor.
3. Manufacturer shall have a minimum of fifteen (15) years continuous experience providing VRF systems in the U.S. market.
4. All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements which may delay emergency service reference are not allowed.
5. The CITY MULTI VRF system shall be installed by a contractor with extensive CITY MULTI install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

2.4 Outdoor Units

R2-SERIES HIGH EFFICIENCY (HEAT RECOVERY), AIR COOLED OUTDOOR UNITS

General:

1. The outdoor unit modules shall be air-cooled, direct expansion (DX), multi-zone units used specifically with VRF components described in this section and Part 5 (Controls). The outdoor unit modules shall be equipped with a single compressor which is inverter-driven and multiple circuit boards—all of which must be manufactured by the branded VRF manufacturer. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.

2. Outdoor unit systems may be comprised of multiple modules with differing capacity if a brand other than basis of design is proposed. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor. Contractor responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, etc.

3. Outdoor unit shall have a sound rating no higher than 68 dB(A) individually or 70 dB(A) twinned. Units shall have a sound rating no higher than 52 dB(A) individually or 55 dB(A) twinned while in night mode operation. Units shall have 5 levels sound adjustment via dip switch selectable fan speed settings. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.

4. Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.

5. The outdoor unit shall have the capability of installing the main refrigerant piping through the bottom of the unit.

6. The outdoor unit shall have an accumulator with refrigerant level sensors and controls. Units shall actively control liquid level in the accumulator via Linear Expansion Valves (LEV) from the heat exchanger.

7. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.

8. VRF system shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.

9. The outdoor unit shall be capable of operating in heating mode down to -25F ambient temperatures or cooling mode down to 23F ambient temperatures, without additional low ambient controls. If an alternate manufacturer is selected, any additional material, cost, and labor to meet low ambient operating condition and performance shall be incurred by the contractor.

10. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained. Oil return sequences must be enabled only during extended periods of reduced refrigerant flow to ensure no disruption to correct refrigerant flow to individual zones during peak loads. Systems which might engage oil return sequence based on hours of operation risk oil return during inopportune periods are not allowed. Systems which rely on sensors (which may fail) to engage oil return sequence are not allowed.

11. Unit must defrost all circuits simultaneously in order to resume full heating more quickly during extreme low ambient temperatures (below 23F). Partial defrost, also known as hot gas defrost which allows reduced heating output during defrost, is permissible only when ambient temperature is above 23F.

12. While in hot gas defrost the system shall slow the indoor unit fan speed down to maintain a high discharge air temperature, systems that keep fan running in same state shall not be allowed as they provide an uncomfortable draft to the indoor zone due to lower discharge air temperatures.

13. In reverse defrost all refrigerant shall be bypassed in the main branch controller and shall not be sent out to the indoor units, systems that flow refrigerant through indoor units during reverse defrost shall not be allowed.

Unit Cabinet:

1. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.

    a) The outdoor unit shall be tested in compliance with ISO9277 such that no unusual rust shall develop after 960 hours of salt spray testing.

    b) Panels on the outdoor unit shall be scratch free at system startup. If a scratch occurs the salt spray protection is compromised and the panel should be replaced immediately.

Fan:

1. Each outdoor unit module shall be furnished with direct drive, variable speed propeller type fan(s) only. Fans shall be factory set for operation at 0 in. WG. external static pressure, but capable of normal operation with a maximum of 0.32 in. WG. external static pressure via dipswitch.

    a) All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.

b) All fans shall be provided with a raised guard to prevent contact with moving parts.

Refrigerant and Refrigerant Piping:

1. R410A refrigerant shall be required for systems.

    a) Polyolester (POE) oil—widely available and used in conventional domestic systems—shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.

    b) Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the VRF equipment manufacturer and installed in accordance with manufacturer recommendations.

    c) All refrigerant piping must be insulated with ½" closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.

    d) Refrigerant line sizing shall be in accordance with manufacturer specifications. Future changes to indoor unit styles or sizes must be possible without resizing/replacing refrigerant piping to any other branch devices or indoor units.

Coil:

1. Outdoor Coil shall be constructed to provide equal airflow to all coil face surface are by means of a 4-sided coil

2. Outdoor Coil shall be elevated at least 12" from the base on the unit to protect coil from freezing and snow build up in cold climates. Manufacturer's in which their coil extends to within a few inches from the bottom of their cabinet frame shall provide an additional 12" of height to their stand or support structure to provide equal protection from elements as Mitsubishi Electric basis of design. Any additional support costs, equipment fencing, and tie downs required to meet this additional height shall be responsibility of Mechanical Contractor to provide.

3. The outdoor heat exchanger shall be of zinc coated aluminum construction with turbulating flat tube construction. The coil fins shall have a factory applied corrosion resistant finish. Uncoated aluminum coils/fins are not allowed.

    a) The coil shall be protected with an integral metal guard.

b) Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.

c) Unit shall have prewired plugs for optional panel heaters in order to prevent any residual ice buildup from defrost. Panel heaters are recommended for operating environments where the ambient temperature is expected to stay below -1F for 72 hours.

d) Condenser coil shall have active hot gas circuit direct from compressor discharge on lowest coil face area to shed defrost condensate away from coil and protect from Ice formation after returning to standard heat pump operation. While in Heat Pump operation this lower section of the Outdoor Evaporator coil shall continually run hot gas from the compressor discharge to protect the coil from ice buildup and coil rupture. Manufacturers who do not have an active hot gas circuit in the lower section of the Outdoor coil to protect coil from freezing shall not be allowed to bid on project in markets where the outdoor unit will see temperatures below freezing.

Compressor:

1. Each outdoor unit module shall be equipped with only inverter driven scroll hermetic compressors. Non inverter-driven compressors, which may cause inrush current (demand charges) and require larger generators for temporary power shall not be allowed.

2. Each compressor shall be equipped with a multi-port discharge mechanism to eliminate over compression at part load. Manufacturer's that rely on a single compressor discharge port and provide no means of eliminating over compression and energy waste at part load shall not be allowed.

3. Crankcase heat shall be provided via induction-type heater utilizing eddy currents from motor windings. Energy-wasting "belly-band" type crankcase heaters are not allowed. Manufacturers that utilize belly-band crankcase heaters will be considered as alternate only.

4. Compressor shall have an inverter to modulate capacity. The capacity for each compressor shall be variable with a minimum turndown not greater than 15%.

5. The compressor shall be equipped with an internal thermal overload.

6. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.

7. Manufacturers that utilize a compressor sump oil sensor to equalize compressor oil volume within a single module shall not be allowed unless they actively shut down the system to protect from compressor failure.

Controls:

1. The unit shall be an integral part of the system & control network described in Part 5 (Controls) and react to heating/cooling demand as communicated from connected indoor units over the control circuit. Required field-installed control voltage transformers and/or signal boosters shall be provided by the manufacturer.

2. Each outdoor unit module shall have the capability of 4 levels of demand control based on external input.

Electrical:

1. The outdoor unit electrical power shall be 208/230 volts, 3-phase, 60 hertz or 460 volts, 3-phase, 60 hertz per equipment schedule.

    a) The outdoor unit shall be controlled by integral microprocessors.

    b) The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

BRANCH CIRCUIT (BC) CONTROLLERS AS REQUIRED FOR SIMULTANEOUS HEAT/COOL SYSTEMS

General

1. BC (Branch Circuit) Controllers (or comparable branch devices) shall include multiple branches to allow simultaneous heating and cooling by allowing either hot gas refrigerant to flow to indoor unit(s) for heating or subcooled liquid refrigerant to flow to indoor unit(s) for cooling. Refrigerant used for cooling must always be subcooled for optimal indoor unit LEV performance; alternate branch devices which do not include controlled refrigerant subcooling risk bubbles in liquid supplied to indoor unit LEVs and are not allowed.

2. BC Controllers (or comparable branch devices) shall be equipped with a circuit board that interfaces to the controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish and be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. BC Controllers (or comparable branch devices) shall be suitable for use in plenums in accordance with UL1995 ed 4.

BC Unit Cabinet:

1. The casing shall be fabricated of galvanized steel.

    a) Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.

    b) The unit shall house two tube-in-tube heat exchangers.

Refrigerant Piping (specifications in addition to those for outdoor unit):

2. All refrigerant pipe connections shall be brazed.

3. Future changes to indoor unit quantities or sizes served by BC Controller or comparable branch device must be possible with no piping changes except between the branch device and indoor unit(s) changing. Systems which might require future piping changes between branch device and outdoor unit—if changes to indoor unit quantities or sizes are made—are not considered equal and are not allowed.

Refrigerant valves:

1. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.

Condensate Management:

1. BC Controller (or comparable branch device) must have integral resin drain pan or insulate refrigeration components with removable insulation that allows easy access for future service needs. Cabinets filled with solid foam insulation do not allow for future service and are not allowed.

Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, 60 Hertz. The unit shall be capable of satisfactory operation within voltage limits of 187-228 (208V/60Hz) or 207-253 (230/60Hz).

    a) The BC Controller shall be controlled by integral microprocessors

    b) The control circuit between the indoor units and outdoor units shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2 Indoor Units

4-WAY CEILING-RECESSED CASSETTE WITH GRILLE INDOOR UNIT

General:

1. The ceiling-recessed indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function, a test run switch, and the ability to adjust airflow patterns for different ceiling heights. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

Unit Cabinet:

1. The cabinet panel shall have provisions for a field installed filtered outside air intake.

    a) Branch ducting shall be allowed from cabinet.

    b) Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.

    c) The grille vane angles shall be individually adjustable from a wired remote controller to customize the airflow pattern for the conditioned space

Fan:

1. The indoor fan shall be an assembly with a statically and dynamically balanced turbo fan direct driven by a single motor with permanently lubricated bearings.

    a) The indoor unit shall include an AUTO fan setting capable of maximizing energy efficiency by adjusting the fan speed based on the difference between controller set-point and space temperature. The indoor fan shall be capable of five (5) speed settings, Low, Mid1, Mid2, High and Auto.

    b) The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.

    c) The indoor unit fan logic must include multiple setting that can be changed to provide optimum airflow based on ceiling height and number of outlets used.

    d) The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.

    e) The vanes shall have an Auto-Wave selectable option in the heating mode that shall randomly cycle the vanes up and down to evenly heat the space.

f) Grille shall include a factory-installed “3D i-see” sensor, or equal, to work in conjunction with indoor unit control sequence to prevent unnecessary cooling or heating in unoccupied areas of the zone without decreasing comfort levels. Sensor must detect occupancy (not simply motion) and location of occupants by measuring size & temperature of objects within a 39’ detecting diameter (based on 8.8ft mounting height) with 1,856 or more measuring points.

Filter:

1. Return air shall be filtered by means of a long-life washable filter

Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.

    a) The coils shall be pressure tested at the factory.

    b) The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 33 inches above the condensate pan.

Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.

    a. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

Controls:

1. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

    a) Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.

    b) Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.

    c) Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

d) A factory-installed drain pan sensor shall provide protection against drain pan overflow by sensing a high condensate level in the drain pan. Should this occur the control shuts down the indoor unit before an overflow can occur. A thermistor error code will be produced should the sensor activate indicating a fault which must be resolved before the unit re-starts.

4-WAY CEILING-RECESSED CASSETTE WITH GRILLE FOR 2X2 GRID INDOOR UNIT

General:

1. The indoor unit shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

Unit Cabinet:

1. The cabinet shall be a compact 22-7/16” wide x 22-7/16” deep so it will fit within a standard 24” square suspended ceiling grid.

a) The cabinet panel shall have provisions for a field installed filtered outside air intake.

b) Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.

Fan:

1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.

a) The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.

b) The indoor fan shall be capable of three (3) speed settings, Low, Mid, and High.

c) The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.

d) The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.

e) Grille shall include an optional “3D i-see” sensor, or equal, to work in conjunction with indoor unit control sequence to prevent unnecessary cooling or heating in unoccupied areas of the zone without decreasing comfort levels. Sensor must detect occupancy (not simply motion) and location of occupants by measuring size & temperature of objects within a 39’ detecting diameter (based on 8.8ft mounting height) with 1,856 or more measuring points.

Filter:

1. Return air shall be filtered by means of a long-life washable filter.

Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.

    a) The coils shall be pressure tested at the factory.

    b) The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 19-3/4” inches above the condensate pan.

Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.

    a) The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

Controls:

1. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

    a) Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.

    b) Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.

    c) Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

    d) A factory-installed drain pan sensor shall provide protection against drain pan overflow by sensing a high condensate level in the drain pan. Should this occur, the control shuts down the indoor unit before an overflow can occur. A thermistor error code will be produced should the sensor activate indicating a fault which must be resolved before the unit re-starts.

MEDIUM STATIC CEILING-CONCEALED DUCTED INDOOR UNIT

General:

1. The ceiling-concealed ducted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

Unit Cabinet:

1. The unit shall be ceiling-concealed, ducted—with a 2-position, field adjustable return and a fixed horizontal discharge supply.

a) The cabinet panel shall have provisions for a field installed filtered outside air intake.

Fan:

1. Indoor unit shall feature multiple external static pressure settings ranging from 0.14 to 0.60 in. WG.

a) The indoor unit fan shall be an assembly with statically and dynamically balanced Sirocco fan(s) direct driven by a single motor with permanently lubricated bearings.

b) The indoor fan shall consist of three (3) speeds, High, Mid, and Low plus the Auto-Fan function

Filter:

1. Filter media installed during construction: Minimum MERV 8 (or Class F5).

2. Filter media installed prior to occupancy: Minimum MERV 13 (or Class F7).

Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.

    a) The coils shall be pressure tested at the factory.

    b) Coil shall be provided with a sloped drain pan. Units without sloped drain pans which must be installed cockeyed to ensure proper drainage are not allowed.

    c) The unit shall be provided with an integral condensate lift mechanism able to raise drain water 27 inches above the condensate pan.

Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.

    a) The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

Controls:

1. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

    a) Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.

    b) Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.

c) Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

HIGH STATIC, CEILING-CONCEALED DUCTED INDOOR UNIT

General:

a) The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

Unit Cabinet:

1. The cabinet shall be ceiling-concealed, ducted with a fixed rear return and a horizontal discharge supply.

a) The cabinet panel shall have provisions for a field installed filtered outside air intake.

Fan:

1. Indoor unit shall feature adjustable external static pressure settings up to 1.00 in. WG.

a) The indoor unit fan shall be an assembly with one or two statically and dynamically balanced Sirocco fan(s) direct driven by a single motor with permanently lubricated bearings.

Filter:

1. Filter media installed during construction: Minimum MERV 8 (or Class F5).

2. Filter media installed prior to occupancy: Minimum MERV 13 (or Class F7).

Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.

a) The coils shall be pressure tested at the factory.

b) Coil shall be provided with a sloped drain pan. Units without sloped drain pans which must be installed cockeyed to ensure proper drainage are not allowed.

Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.

    a) The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

Controls:

1. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

    a) Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.

    b) Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.

Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

VERTICAL/HORIZONTAL DUCTED (MULTI-POSITION AIR HANDLER)

General:

1. The multi-position indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in air handling spaces in accordance with Section 18.2 of UL 1995 4th Edition, be tested in accordance with ANSI/ASHRAE 193 and have less than 2% air leakage at maximum airflow setting.

Unit Cabinet:

1. The cabinet shall include a fixed bottom return, a fixed vertical discharge supply and be pre-painted, pre-insulated, 22 gauge galvanized steel.

Fan:

1. The indoor unit fan shall be an assembly with a single, statically and dynamically balanced direct drive fan with a high efficiency DC motor with permanently lubricated bearings.

2. The fan shall have 3-speeds with the capability to operate between 0.3-0.8 In.WG selectable.

Filter:

2. Filter media installed during construction: Minimum MERV 8 (or Class F5).

3. Filter media installed prior to occupancy: Minimum MERV 13 (or Class F7).

Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.

2. The coils shall be pressure tested at the factory.

Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.

2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

Optional Electric Heat Kit:

1. The indoor unit shall have a manufacturer supplied electric heat kit accessory. The electric heat kit shall offer either one or two stages of back up heat for maximum efficiency. The heater shall be designed to work with the indoor unit without any modifications to the unit or to the control sequence.

Controls:

1. Control board shall include contacts for control of no less than two stages of external heat. The first stage of external heat may be energized when the space temperature is 2.7°F from set point for between 10-25 minutes (user adjustable). The second stage of external heat may be energized when the first stage has been active for no less than 5 minutes and the space temperature has not risen by more than 0.9°F.

2. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.

3. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

Part 2 - Controls

OVERVIEW

The control system shall consist of a low voltage communication network and a web-based interface. The controls system shall gather data and generate web pages accessible through

a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.

Furnish energy conservation features such as optimal start, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.

System shall be capable of email generation for remote alarm annunciation.

ELECTRICAL CHARACTERISTICS

General:

1. Controller power and communications shall be via a common non-polar communications bus and shall operate at 30VDC.

Wiring:

1. Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.

2. Control wiring for centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to the system controllers (centralized controllers and/or integrated web based interface), to the power supply.

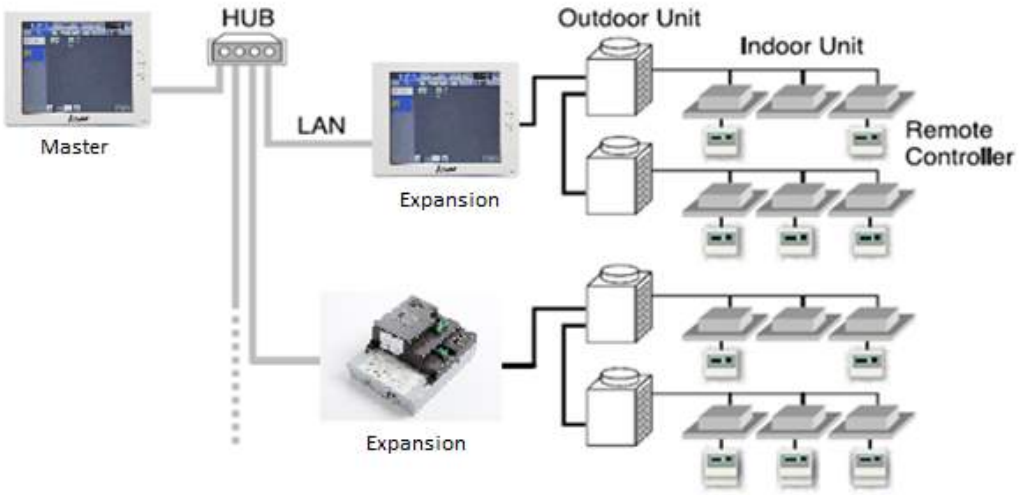
Wiring type:

1. Wiring shall be 2-conductor (16 AWG), twisted, stranded, shielded wire as defined by the Diamond System Builder output.

2. Network wiring shall be CAT-5 with RJ-45 connection.

CITY MULTI CONTROLS NETWORK

3. The CITY MULTI Controls Network (CMCN) consists of remote controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The CITY MULTI Controls Network shall support operation monitoring, scheduling, occupancy, error email distribution, personal web browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either LonWorks® or BACnet® interfaces. The below figure illustrates a sample CMCN System Configuration.



CMCN System Configuration

CENTRALIZED CONTROLLER (WEB-ENABLED)

Master Centralized Controller:

4. The Master Centralized Controller shall be capable of controlling a maximum of two hundred (200) indoor units across multiple CITY MULTI outdoor units with the use of three expansion controllers. The Master Centralized Controller shall be approximately 11-5/32" x 7-55/64" x 2-17/32" in size and shall be powered with an integrated 100-240 VAC power supply. The Master Centralized Controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, night setback settings, free contact interlock configuration and malfunction monitoring. When being used alone without the expansion controllers, the Master Centralized Controller shall have five basic operation controls which can be applied to an individual indoor unit, a collection of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the Master Centralized Controller shall include on/off, operation mode selection (cool, heat, auto (R2/WR2-Series only), dry, setback (R2/WR2-Series only) and fan), temperature setting, fan speed setting, and airflow direction setting. Since the master provides centralized control it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the Master Centralized Controller shall allow the user to define both daily and weekly schedules (up to 24 scheduled events per day) with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.

Master Centralized Controller			
Item	**Description**	**Operation**	**Display**
ON/OFF	Run and stop operation.	Each Block, Group or Collective	Each Group or Collective
Operation Mode	Switches between Cool/Dry/Auto/Fan/Heat. (Group of Lossnay unit: automatic ventilation/vent-heat/interchange/normal ventilation) Operation modes vary depending on the air conditioner unit. Auto mode is available for the R2/WR2-Series only.	Each Block, Group or Collective	Each Group
Temperature Setting	Sets the temperature from 57°F – 87°F depending on operation mode and indoor unit.	Each Block, Group or Collective	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Block, Group or Collective	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model. *1. Louver cannot be set.	*1 Each Block, Group or Collective	Each Group
Schedule Operation	Annual/weekly/today schedule can be set for each group of air conditioning units. Optimized start setting is also available. *1. The system follows either the current day, annual schedule, or weekly, which are in the descending order of overriding priority.	*2 Each Block, Group or Collective	Each Group

Master Centralized Controller			
Item	**Description**	**Operation**	**Display**
	Twenty-four events can scheduled per day, including ON/OFF, Mode, Temperature Setting, Air Direction, Fan Speed and Operation Prohibition. Five types of weekly schedule (seasonal) can be set. Settable items depend on the functions that a given air conditioning unit supports.		
Optimized Start	Unit starts 5 - 60 minutes before the scheduled time based on the operation data history in order to reach the scheduled temperature at the scheduled time.	Each Block, Group or Collective	Each Block, Group or Collective
Night Setback Setting	The function helps keep the indoor temperature in the temperature range while the units are stopped and during the time this function is effective.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *3. Centrally Controlled is displayed on the remote controller for prohibited functions.	Each Block, Group or Collective	*3 Each Group
Room Temp	Displays the room temperature of the group. Space temperature displayed on the indoor unit icon on the touch screen interface.	N/A	Each Group
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed *4. When an error occurs, the LED flashes. The operation monitor screen shows the abnormal unit by flashing it. The error monitor screen shows the abnormal unit address, error code and source of detection. The error log monitor screen shows the time and date, the abnormal unit address, error code and source of detection	N/A	*4 Each Unit or Collective
Outdoor Unit Status	Compressor capacity percentage and system pressure (high and low) pressure (excludes S-Series)	Each ODU	Each ODU
Connected Unit Information	MNET addresses of all connected systems	Each IDU, ODU and BC	Each IDU, ODU and BC
Ventilation Equipment	This interlocked system settings can be performed by the master system controller. When setting the interlocked system, use the ventilation switch the free plan LOSSNAY settings between “Hi”, “Low” and “Stop”. When setting a group of only free plan LOSSNAY units, you can switch between “Normal ventilation”, “Interchange ventilation” and “Automatic ventilation”.	Each Group	Each Group
Multiple Language	Other than English, the following languages can be selected: Spanish, French, Japanese, Dutch, Italian, Russian, Chinese, and Portuguese.	N/A	Collective
External Input / Output	By using accessory cables you can set and monitor the following. Input By level: “Batch start/stop”, “Batch emergency stop” By pulse: “batch start/stop”, “Enable/disable remote controller” Output: “start/stop”, “error/Normal” *5. Requires the external I/O cables (PAC-YG10HA-E) sold separately.	*5 Collective	*5 Collective

5. All Master Centralized Controllers shall be equipped with two RJ-45 Ethernet ports to support interconnection with a network PC via a closed/direct Local Area Network (LAN) or to a network switch for IP communication to up to three expansion controllers for display of up to two hundred (200) indoor units on the main master centralized controller interface.

6. The Master Centralized Controller shall be capable of performing initial settings via the high-resolution, backlit, color touch panel on the controller or via a PC browser using the initial settings.

7. Standard software functions shall be available so that the building manager can securely log into each master centralized controller via the PC's web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics. Additional optional software functions of personal browser for PCs and MACs and Energy shall be available but are not included. The Energy Apportionment function shall require a LIC-Charge software license

Expansion Controller:

1. The Expansion Controller shall serve as a standalone centralized controller or as an expansion module to the Master Centralized Controller for the purpose of adding up to 50 indoor units to either the main touch screen interface of the master centralized controller. Up to three (3) expansion controllers can be connected to the master via a local IP network (and their IP addresses assigned on the master) to the master to allow for up to two hundred (200) indoor units to be monitored and controlled from the master interface.

2. The expansion controllers have all of the same capabilities to monitor and control their associated indoor units as the features specified above. Even when connected to the master and configured to display their units on the main controller, the individual indoor units connected to the expansion can still be monitored and controlled from the interface of the expansion. The last command entered will take precedence, whether at the wall controller, the expansion or the master Centralized Controller.

Non Touch Screen, Networked Centralized Controller:

1. The Non Touch Screen, Networked Centralized Controller shall be capable of controlling a maximum of 50 indoor units across multiple CITY MULTI outdoor units. The controller shall be approximately 8-1/2”x10” in size and shall be powered by its internal power supply. The controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, free contact interlock configuration and malfunction monitoring. The controller shall have five basic operation controls which can be applied to an individual indoor unit, a group of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the controller shall include on/off, operation mode selection (cool, heat, auto (R2/WR2-Series only), dry, temperature setting, fan speed setting, and airflow direction setting. Since the controller provides centralized control it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the controller shall allow the user to define both daily and weekly schedules with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.

Non Touch Screen, Networked Centralized Controller			
Item	**Description**	**Operation**	**Display**
ON/OFF	Run and stop operation.	Each Block, Group or Collective	Each Group or Collective
Operation Mode	Indoor unit modes: COOL/DRY/FAN/AUTO/HEAT. Lossnay unit modes: HEAT RECOVERY/BYPASS/AUTO Air to water (PWFY) modes: HEATING/HEATING ECO/HOT WATER/ANTI-FREEZE/COOLING *Operation modes vary depending on the unit model connected. ** Auto mode is available for the R2/WR2-Series only.	Each Block, Group or Collective	Each Group
Temperature Setting	Sets the temperature from 40°F – 95°F depending on operation mode and indoor unit model. Separate COOL and HEAT mode set points available depending on remote controller and connected mechanical equipment.	Each Block, Group or Collective	Each Group
Set Temperature Range Limit	The range of room temperature setting can be limited by the initial setting depending on the indoor unit connected.	Each Group	Each Group
Fan Speed Setting	Available fan speed settings depend on indoor unit model.	Each Block, Group or Collective	Each Group
Air Flow Direction Setting	*Air flow direction settings vary depending on the indoor unit model. *1. Louver cannot be set.	*1 Each Block, Group or Collective	Each Group

Non Touch Screen, Networked Centralized Controller			
Item	**Description**	**Operation**	**Display**
Schedule Operation	Annual/weekly/today schedule can be set for each group of air conditioning units. Optimized start setting is also available. *2. The system follows either the current day, annual schedule, or weekly, which are in the descending order of overriding priority. Twenty-four events can scheduled per day, including ON/OFF, Mode, Temperature Setting, Air Direction, Fan Speed and Operation Prohibition. Five types of weekly schedule (seasonal) can be set. Settable items depend on the functions that a given air conditioning unit supports.	*2 Each Block, Group or Collective	Each Group
Hold	Disables scheduled functions for indoor unit groups and their associated remote controller timers. *not available for general equipment	Each Block, Group or Collective	Each Group
Optimized Start	Unit starts 5 - 60 minutes before the scheduled time based on the operation data history in order to reach the scheduled temperature at the scheduled time.	Each Block, Group or Collective	Each Block, Group or Collective
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Fan Speed, Air Direction and Reset filter). *3. Centrally Controlled is displayed on the remote controller for prohibited functions.	Each Block, Group or Collective	*3 Each Group
Room Temp	Displays the room temperature of the group.	N/A	Each Group
Room Humidity	Displays the percent relative humidity in the space as sensed by the Smart ME Remote Controller	N/A	Each Group
Occupancy Sensor	Displays the occupancy icon on the group icon in the condition list page when the room is occupied (blue) or vacant (gray). *The Smart ME Remote Controller Occupancy sensor is required.	N/A	Each Group
Brightness Sensor	Displays the brightness icon on the group icon in the condition list when the space is determined to be bright (yellow) or dark (gray). *The Smart ME Remote Controller Brightness sensor is required.	N/A	Each Group
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed *4. When an error occurs, the LED flashes. The operation monitor screen shows the abnormal unit by flashing it. The error monitor screen shows the abnormal unit address, error code and source of detection. The error log monitor screen shows the time and date, the abnormal unit address, error code and source of detection	N/A	*4 Each Unit or Collective
Ventilation Equipment	This interlocked system settings can be performed by the master system controller. When setting the interlocked system, use the ventilation switch the free plan LOSSNAY settings between “Hi”, “Low” and “Stop”.	Each Group	Each Group

Non Touch Screen, Networked Centralized Controller			
Item	**Description**	**Operation**	**Display**
	When setting a group of only free plan LOSSNAY units, you can switch between “Normal ventilation”, “Interchange ventilation” and “Automatic ventilation”.		
Multiple Language	Other than English, the following languages can be selected: Spanish, French, Japanese, German, Italian, Russian, Chinese, and Portuguese.	N/A	N/A
External Input / Output	By using accessory cables you can set and monitor the following. Input: By level: “Batch start/stop”, “Batch emergency stop”; By pulse: “batch start/stop”, “Enable/disable remote controller” Output: “start/stop”, “error/Normal” *5. Requires the external I/O cables (PAC-YG10HA-E) sold separately.	*5 Collective	*5 Collective
M-Net	The "M-NET" LED lights, when AC power supply is turned ON. The LED blinks while M-NET is communicating.	N/A	Each Group (LED)
Collective ON/OFF	All the units can be operated / stopped with a DIP switch.	Collective	N/A
Measurement	Displays the Temperature and Humidity inputs of the AI Board. Supports graph display and data export.	N/A	Each Unit
AHC Status	Displays the status of the of the inputs and outputs of each Advanced HVAC Controller (DC-A2IO)	N/A	Each Unit
Free Contact Status	Displays the input/output status of the Free Contacts on the indoor units	N/A	Each Unit
Free Contact Interlock Control	Operation of indoor groups, general equipment or free contact outputs based on group(s) conditions or free contact(s) input states.	Each Group, Output or Collective	N/A
Data Back-up (PC)	Initial setting data can be exported to a PC.	Collective	N/A

2. All Non Touch Screen, Networked Centralized Controller shall be equipped with two RJ-45 Ethernet port to support interconnection with a network PC and BACnet/IP communication via a closed/direct Local Area Network (LAN). The controller shall be capable of performing initial settings online via a PC using the controller's initial setting browser or online/offline with the Initial Setting Tool.

3. Standard software functions shall be available so that the building manager can securely log into each controller via the PC's web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics. Standard software functions shall not expire. Additional optional software functions of personal browser for PCs and MACs and Energy Allocation shall be available. The Energy Allocation function shall require Master Centralized Controller Energy Allocation Integrated System in conjunction with Non Touch Screen, Networked Centralized Controller.

GRAPHICAL USER INTERFACE

The Graphical User Interface (Integrated Centralized Control Web) shall require a field supplied PC or Tablet.

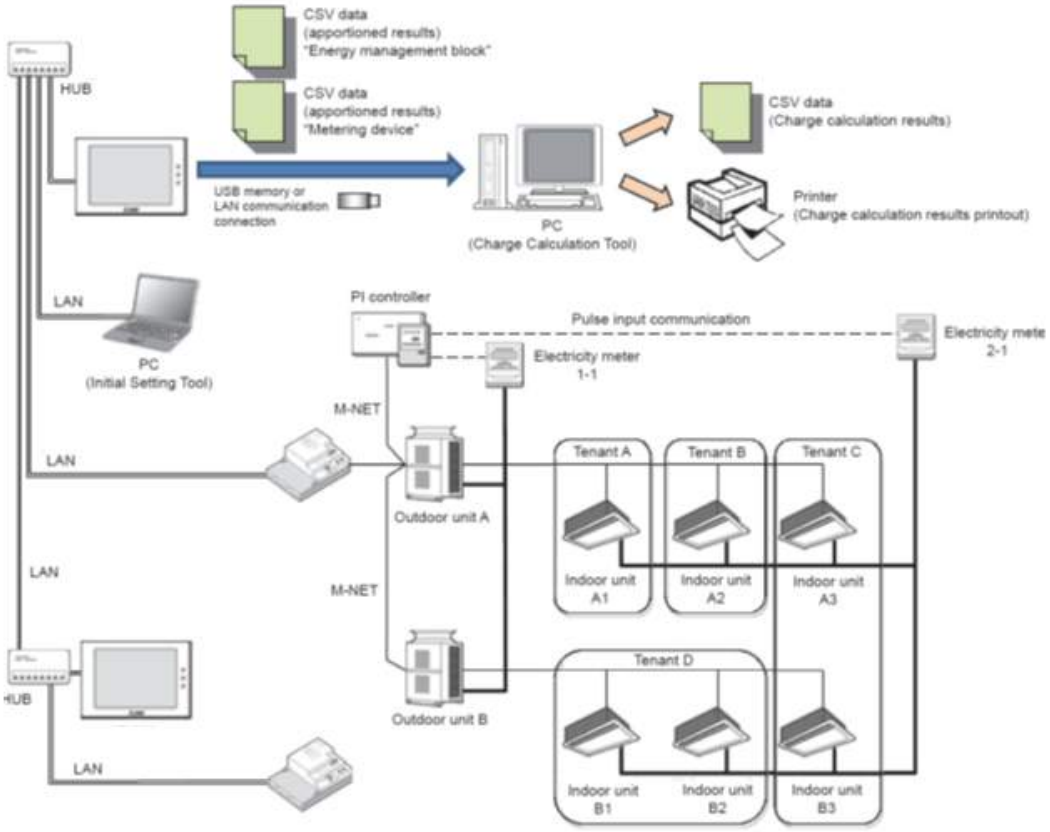
ICCW

4. The Integrated Centralized Control Web System (ICCW) interface shall enable the user to control multiple networked central controllers and shall provide additional functions such as energy apportionment from a single network PC configured with the Charge Calculation Tool. The ICCW shall be capable of controlling up to forty networked Centralized Controllers with a maximum of 2,000 indoor units across multiple CITY MULTI outdoor units. The ICCW shall be required if the user wants to simultaneously control more than 1 Centralized Controllers from a single PC or tablet using a single web browser session. Licensing per function, per Centralized Controller shall be required for the ICCW. Optional software features shall be available through the ICCW including energy apportionment and personalized web. These optional software features shall require the ICCW, advance purchase from the customer, and licensing from ICCW.

ICCW (Integrated System Software)	
Item	**Details**
ON/OFF	The units can turn ON and OFF for all floors or in a block, floor, or group of units.
Operation Modes	The operation mode can be switched between COOL, DRY, FAN, AUTO, and HEAT for all floors or in a block, floor, or group of units
Temperature Setting	Sets the temperature for a single group. Range of Temperature setting from 57°F – 87°F depending on operation mode and indoor unit model. Separate COOL and HEAT mode set points available depending on remote controller and connected mechanical equipment.
Fan Speed	The fan speed can be set to four stages for all floors or in a block, floor, or group of units

ICCW (Integrated System Software)	
Item	**Details**
Air Direction	The air direction can be set in four vertical directions or to swing for all floors or in block, floor, or group of units. (The selectable air direction differs according to the model.)
Interlocked Unit ON/OFF LOSSNAY	If there is an interlocked unit (LOSSNAY), then the unit can be turned ON (strong/weak) or OFF for all floors or in a block, floor, or group of units. (Note that the ventilation mode cannot be selected for interlocked units.)
Local Operation Prohibit	The items for which operation with the local remote controller are to be prohibited can be selected for all floors or in a block, floor, or group of units. (The items that can be prohibited are ON/OFF, operation mode, set temperature and filter sign reset.)
Annual / Weekly Schedule	The annual/weekly schedule function can be used by registering the license. Two settings, such as seasonal settings for summer and winter, can be saved.
Power Rate Apportionment Charging	A watt-hour meter (WHM) with kWH pulse output is connected to calculate the air conditioning charges based on the amount each tenant's air-conditioner has operated. Five charging rates can be applied per day. ***OPTIONAL ENERGY APPORTIONMENT SOFTWARE (LIC-CHARGE) and PI Controller (PAC-Y60MCA) REQUIRED
History	Up to 3,000 items for the error history and up to 10,000 items for operation history can be saved. Each history file can be output as a daily report or monthly report in CSV format. (The operation history consists only of the operations carried out with the ICCW and is limited to some limited operation items.)
Operation Time Monitor	The cumulative operation time of each indoor unit can be viewed or output as a CSV format file. (This function is valid only when the charging function license is registered.)
Filter Sign Display Mask	The filter sign display at the remote controllers can be disabled.
Set Temperature Limit	The set temperature lower limit can be set for cooling and the upper limit for heating. (ME remote controller required)

ENERGY APPOINTMENT METHOD FOR CITY MULTI CENTRALIZED CONTROLLERS



CMCN System Configuration

System Overview

5. For centralized systems serving multiple tenants for which one-to-one electricity metering is not possible, an apportioned electricity billing function that attributes just the electrical energy consumed by each individual tenant's air conditioner is required. The Energy Apportionment function takes the information on the electrical energy usage gathered from Watt Hour Meters (WHM) connected to dedicated breaker panels serving the system's outdoor units and synthesizes it with the information on the operating status of the indoor units that is collected by the CITY MULTI centralized controller(s).

Watt Hour Meters

1. Requirements:

- The Watt Hour Meters (WHMs) to be used to read the electrical energy consumption of the outdoor units must be capable of a pulse output, which would be configured based on the current rating of the units. The associated current transformers/ transducers (CTs) must also be sized based on the current rating of either the individual outdoor units or the dedicated air conditioning electrical panels they are to be reading. The proper quantity of meters for a particular sized system must be selected in order to ensure sufficient resolution and hysteresis in the unit pulse output of the meters so as to ascribe an acceptable level of accuracy to the apportionment of energy usage for each tenant's system. The system is designed to work with any WHM capable of a pulse output that meets ANSI C12.20 class 0.2% or 0.5% accuracy standards.

2. Connection:

- The WHMs are to be physically connected to the integrated pulse input module or an external Mitsubishi Electric PI Controller if such an input is not available or if there is a wiring length limitation or installation hardship. The cable type of the interconnecting wiring shall be according to the wiring specifications of the WHM manufacturer.

CITY MULTI Centralized Controller Requirements

1. Licensing:

- Each centralized controller to which units are assigned that require the energy apportionment function must have the "LIC-Charge" software license purchased and properly unlocked in order to enable the operating status of the indoor units to be passed to the energy apportionment tool. The procedure for licensing the centralized controllers with this function and the necessary forms can be found on Mitsubishi Electric's technical documentation repository, mylinkdrive.com. Purchase Order information for the licenses will be required at the time of submission of the licensing request forms.

2. Dedicated master centralized controller for apportionment (no MNET connection)

- A dedicated master centralized controller, for which the LIC-Charge license is purchased and the energy apportionment function enabled, must be provided in order to serve as the portal for exporting metering device and energy management data to a USB drive or to a PC via LAN connection. This means that by virtue of selecting this master centralized controller to serve this function, the MNET capability of this particular centralized controller will be disabled. All indoor units must be physically wired via MNET to other expansion centralized controllers, which must be physically wired via LAN with Static IP addresses and a network hub or switch to the master apportionment controller.

PC for collecting charge calculation results

- A networked PC, which does not necessarily have to be dedicated to the task of collecting energy apportionment data, can be provided and loaded with the Charge Calculation Tool software for exporting data necessary to generate billing documentation to be performed by a third party. The system requirements of the PC are as follows:

Item	Requirements
CPU	1 GHz or better (at least 2 GHz recommended)
Memory	2GB or more
Screen Resolution	1024 x 768 or better
OS	Windows 7, Windows 8.1 (32bit/64bit)
System requirements	The system should meet the minimum requirement for Windows 7 or Windows 8.1 • Net Framework 4.5 or later
Internal LAN port or LAN card	100 BASE-TX or better
Porting device	Mouse, etc.

CMCN: SYSTEM INTEGRATION

BACnet® Integration:

1. The Mitsubishi Electric Cooling & Heating BACnet® hardware, which is built into all networked central controllers, shall be compliant with BACnet® Protocol (ANSI/ASHRAE 135-2010) and be Certified by the (BTL) BACnet® Testing Laboratories. The BACnet® interface shall support BACnet Broadcast Management (BBMD). The BACnet® interface shall support a maximum of 50 indoor units. Operation and monitoring points include, but are not limited to, on/off, operation mode, fan speed, prohibit remote controller, filter sign reset, alarm state, error code, and error address.

2. Licenses:

   - LIC-BACnet Master: Master Controller license for Master Centralized Controller and Non Touch Screen, Networked Centralized Controller
   - LIC-BACnet Expansion: Expansion Controller license for Expansion Controller and Non Touch Screen, Networked Centralized Controller

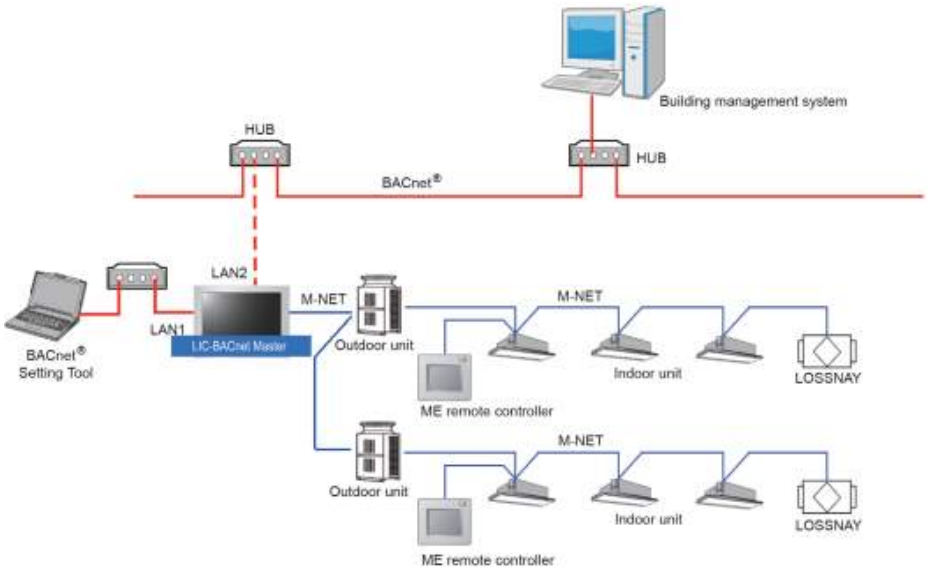
3. LIC-BACnet Specifications:

   - Control up to 50 groups
   - 1 to 16 indoor units can be collectively controlled in a group
   - Supports dual set point functionality (connected model dependant)
   - BTL Compliant
   - BACnet communication specifications are based on ANSI/ASHRAE Standards 135-2010

4. PC Requirements:

   - CPU: 1GHz or higher
   - Memory: 1GB or more
   - HDD Space: 100 MB or more
   - Screen Resolution: 1024 x 768 or higher
   - OS: Microsoft Windows 7 32-bit/64-bit, Microsoft 8.1 32-bit/64-bit. Not compatible with Windows Vista
   - Execution Environment: Microsoft .NET Framework 4.5 or later
   - Others: Pointing device such as a mouse, internet connection (required when installing a .NET Framework)

5. LIC-BACnet – System Example



6. BACnet Point List

Object List
On Off Setup
On Off State, Number of ON/OFF, Cumulative operation time
Alarm Signal (4-digit error code)
Error Code
Operational Mode Setup
Operational Mode State
Fan Speed Setup
Fan Speed State
Room Temp [Water Temp]
Set Temp [Set Water Temp]
Set Temp Cool
Set Temp Heat
Set Temp Auto
Filter Sign [Circulating Water Exchange Sign]
Filter Sign Reset [Circulating Water Exchange Sign Reset]
Prohibition On Off
Prohibition Mode
Prohibition Filter Sign Reset [Prohibition Circulating Water Exchange Sign Reset]
Prohibition Set Temperature
M-NET Communication State
System Forced Off
Air Direction Setup
Air Direction State
Set High Limit Setback Temp
Set Low Limit Setback Temp
Ventilation Mode Setup
Ventilation Mode State
Air To Water Mode Setup

System Alarm Signal (4-digit error code)
PI Controller Alarm Signal (4-digit error code)
Group Apportioned Electric Energy
Interlocked Units Apportioned Electric Energy
PI controller Electric Energy 1–4
Pulse Input Electric Energy 1–4
Group Apportionment Parameter
Interlocked Units Apportionment Parameter
Night Purge State
Thermo On Off State
Trend Log Room Temp
Trend Log Group Apportioned Electric Energy
Trend Log Interlocked Units Apportioned Electric Energy
Trend Log PI controller Electric Energy 1–4
Trend Log Pulse Input Electric Energy 1–4
Trend Log Group Apportionment Parameter
Trend Log Interlocked Units Apportionment Parameter

1.

2.2

2.3 ISOLATION VALVES

A. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.

2.4 SOLENOID VALVES

A. Solenoid valves shall be field-provided or factory installed at each branch selector box (BS-Box) and at each condensing unit.

B. Refer to specification section 23 23 00, Refrigerant piping, for solenoid valve requirements

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of units.

B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where condensing units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.

B. Install roof-mounting units on equipment supports specified in Division 07.

C. Vibration Isolation: Mount condensing units on Vibration isolation devices. Installation requirements are specified in Division 23 Section: "Vibration and Seismic Controls for HVAC Piping and Equipment.

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Install floor mounted units on 4" high concrete housekeeping pads. Pad to be 6" wider then the unit on all sides. Refer to Division 23 Section: Cast-In-Place Concrete.

F. Install flexible connections between unit and inlet and discharge ductwork. Install metal bands of connectors parallel with minimum 3 inch flex between ductwork and fan while running. Refer to Division 23 Section: "HVAC Air Distribution."

G. Install components furnished loose for field mounting.

H. Install connection to electrical power wiring in accordance with Division 26.

I. Unless otherwise indicated install condensate piping with trap and route from drain pan to nearest floor drain Refer to Division 23 Section: "Pipes and Tubes for HVAC Piping and Equipment".

J. Install Work in accordance with all applicable codes, standards, and local authorities having jurisdiction requirements.

K. All wiring within the unit, where inside a control panel, shall be installed in UL approved conduit or raceway.

L. Refrigerant circuit access ports located outdoors shall be fitted with locking-type-tamper-resistance caps.

M. Install refrigerant piping from unit to condensing unit. Install refrigerant specialties specified in Division 23 Section: "Refrigerant Piping."

N. Evacuate refrigerant piping and install initial charge of refrigerant.

O. Install control wiring between air handling unit, condensing unit, and field installed accessories.

P. Install Work in accordance with all applicable codes, standards, and local authorities having jurisdiction.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to units to allow service and maintenance.

C. Connect refrigerant piping to air-cooled units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Division 23 Section: “Refrigerant Piping”.

D. Ground equipment according to Division 26 Section: Grounding and Bonding for Electrical Systems”.

E. Connect wiring according to Division 26 Section “Low-Voltage Electrical Power Conductors and Cables”.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Perform electrical test and visual and mechanical inspection.
2. Leak Test: After installation, change systems with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Verify proper airflow over coils.

B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

C. Remove and replace malfunctioning condensing units and retest as specified above.

3.5 STARTUP SERVICE

A. Complete installation and startup checks according to manufacturer’s written instructions and perform the following:

1. Inspect for physical damage to unit casing.
2. Verify that access doors move freely and are weather tight.
3. Clean units and inspect for construction debris.
4. Verify that all bolts and screws are tight.
5. Adjust vibration isolation and flexible connections.
6. Verify that controls are connected and operational.

B. Lubricate bearings on fans.

C. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

D. Start unit according to manufacturer’s written instructions and complete manufacturer’s startup checklist.

E. Measure and record airflow over coils.

F. Verify proper operation of condenser capacity control device.

G. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

H. After startup and performance test, lubricate bearings.

3.6 CLEANING

A. Division 01 Section – "Execution and Closeout Requirements": Requirements for cleaning.

B. Vacuum clean coils and inside of unit cabinet.

C. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.

3.7 DEMONSTRATION AND TRAINING

A. Division 01 Section: "Execution and Closeout Requirements": Requirements for demonstration and training.

B. Demonstrate air handling unit operation and maintenance.

C. Demonstrate starting, maintenance, and operation of condensing unit including low ambient temperature operation.

D. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain systems.

1. Train Owner's maintenance personnel on procedures and schedules for starting up and shutting down, trouble shooting, servicing and maintaining air handling units.
2. Review data in maintenance manuals. Refer to Division 1 Section: "Contract Closeout Procedures".
3. Schedule training with owner with at least seven (7) days advance notice.

E. Furnish services of manufacturer's technical representative for one 8 hour day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days' notice to Architect/Engineer of training date.

3.8 VARIABLE REFRIGERANT FLOW SYSTEM

A. General

1. The installation shall be in accordance with the manufacturer's Installation, Operating and Maintenance Instructions with regard to application, mechanical and electrical requirements. It shall be the responsibility of the contractor to carry out proper installation and guarantee operational status.
2. Refrigerant piping associated with equipment that must be relocated due to field conditions shall be resized and approved by the VRV system manufacturer.

3.9 MANUFACTURER'S FIELD SERVICES

A. Division 01 Section: “Quality Requirements”: Requirements for field services.

B. The manufacturer shall furnish complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.

C. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

D. Furnish services of factory; trained representative for minimum of two days to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.10 PROTECTION OF FINISHED WORK

A. Division 01 Section**:** “Execution and Closeout Requirements” for requirements for protecting finished work.

B. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

3.11 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section “Commissioning”.

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable

END OF SECTION

SECTION 23 82 00
TERMINAL HEATING AND COOLING UNITS

PART 1 - ENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specifications, apply to this section, and the other sections of Division 23.

1.2 SUMMARY

A. Section includes:

1. Electric ceiling heaters.
2. Electric unit heaters.
3. Electric wall heaters.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 23 Section: “Common Motor Requirements”: Product requirements for electric motors for placement by this section.
2. Division 23 Section: “HVAC Insulation”: Product requirements for insulation for placement by this section.
3. Division 23 Section: “Pipes and Tubes for HVAC Piping and Equipment”:
4. Division 23 Section: “Refrigerant Piping”: Execution requirements for connection of refrigerant piping to units specified by this section.
5. Division 23 Section: HVAC Air Distribution”: Product requirements for flexible duct connections for placement by this section.
6. Division 26 Section: “Low Voltage Electrical Power Conductors and Cables:” Requirements for electric wiring and connections to units specified by this section.
7. Division 26 Section: “Raceways and Boxes for Electrical Systems:” Requirements of conduits and boxes housing electrical wiring and connections specified by this section.

1.3 REFERENCES

(Unless otherwise noted, references apply to “latest editions.”)

A. Air-Conditioning and Refrigeration Institute:

1. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.

B. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.4 SUBMITTALS

A. Division 01 Section: “Submittal Procedures”: Submittal Procedures.

B. Shop Drawings: Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations. Indicate schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers.

C. Product Data: Submit coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions. Submit mechanical and electrical service locations, capacities and accessories or optional items.

D. Samples: Submit one sample of each radiation cabinet detailed.

E. Manufacturer's Installation Instructions: Submit assembly, support details, and connection requirements.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Submission of all submittals shall be made electronically via email with PDF attachments to bowman_submit@bowman.com

1.5 CLOSEOUT SUBMITTALS

A. Division 01 Section: “Execution and Closeout Requirements”: Closeout procedures.

B. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access to valves.

C. Operation and Maintenance Data: Submit manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with all applicable codes, standards and local authorities having jurisdiction requirements.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS

A. Division 01 Section: "Administrative Requirements": Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Division 01 Section: "Product Requirements": Product storage and handling requirements.

B. Accept units on site in factory packing. Inspect for damage. Store under roof.

C. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors. Protect coils from entry of dirt and debris with pipe caps or plugs.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

A. Division 01 Section: "Execution and Closeout Requirements": Product warranties and product bonds.

B. Furnish two-year manufacturer's warranty for equipment.

PART 2 - PRODUCTS

2.1 ELECTRIC UNIT HEATERS (UH-1.01 - UH-1.06)

A. Basis of Design:

1. Units shall meet model number, types, sizes, capacities and electrical characteristics as indicated on the contract drawings.
2. Basis of design shall be model number "MWUH" manufactured by QMark, comparable products manufactured by Berko, Brasch, Chromalox, Marley, and Trane shall be submitted for review as comparable products.

B. The electric unit heaters shall be fully UL approved, designed for wall mounting without modification and operate at the voltages and heat capacities listed on the contract drawings.

C. Housing: The cabinet shall be of heavy gauge steel, welded and phosphatized; then completely painted desert tan by a baked enamel painting process. Front and back panels shall be removable to gain full access to element, motor and fan area. Fan guard shall be painted to match heater for appearance and durability. Heaters shall be furnished with attached ceiling mounting bracket and shall be capability of full horizontal

position. Heaters shall be so designed as to permit mounting within two inches of the ceiling in full horizontal mode.

D. Control Box: The control box, housing all heater wiring and controls, shall be located at the bottom of the heater and equipped with a swing down hinged cover to permit full access for installation and servicing without dismounting the heater.

E. Wiring: All heater and control wiring connections shall terminate in the control box. Proper wiring diagram shall be attached to the inside of the control box cover. 60° C wire may be used to bring entry wiring into compartment.

F. Fan Motor: Fan motor shall be totally enclosed, impedance protected and of unit bearing design suitable for horizontal or vertical operation with high starting and running torques. Fan motor and controls shall operate directly from the line voltage.

G. Heating Element: The heating element shall be warranted for five years and shall be of non-glowing design consisting of a special resistance wire enclosed in the steel sheath to which steel plate fins are brazed. The heating element shall cover the entire air discharge area for uniform heating.

H. Thermal Cutout: Thermal cutout shall be built into the system to automatically shut off heater in event of overheating and reactivate the heater when temperatures return to normal.

F. Additional Requirements:

1. Heating only thermostat.
2. Electrical disconnect switch.
3. Hanging bracket.
4. Vibration isolators. Refer to Division 23 Section “Vibration Controls for HVAC Piping and Equipment.”

2.2 ELECTIC WALL HEATERS (**EWH-1.XX**)

A. Basis of Design:

1. Electric wall heaters shall meet model number, types, sizes, capacities and electrical characteristics as indicated on the contract drawings.
2. Basis of design shall be model number “AWH” manufactured by QMark, comparable products manufactured by Berko, Brasch, Chromalox, Marley and Trane shall be submitted for review as comparable products.

B. The heating equipment shall include electric, automatic fan forced air heater suitable for large area heating. The heater shall be designed for surface mounting. Heaters shall be UL listed or equivalent (ETL).

C. Heater Assembly: The heater assembly which fits into the back box shall consist of a fan panel upon which is mounted all the operational parts of the heater.

D. Heating Element: The heating element shall be of the non-glowing design consisting of a special resistance wire enclosed in a steel sheath to which steel plate fins are copper brazed. It shall be warranted for 5 years.

E. Fan and Motor: Fan shall be five-bladed aluminum. Fan motor shall be totally enclosed.

F. Fan Delay Switch: Fan control shall be of bi-metallic, snap-action type and shall activate fan after heating element reaches operating temperature. The fan shall continue to operate after the thermostat is satisfied and until the heating element is cool.

G. Thermosat: The tamper-proof thermostat shall be of the bi-metallic snap-action type with enclosed contacts. It shall be completely concealed behind the front cover to become tamper proof.

H. Thermal Cutout: A manual-reset thermal cutout shall be built into the system to shut off the heater in the event of overheating.

I. Power On/Off Switch: A double-pole, single throw ON/OFF switch shall be mounted on the back box for positive disconnect of power supply. It will be completely concealed behind the front grille panel.

J. Back Box: The back box shall be designed for duty as a recessed rough-in box in either masonry or frame installations, and is also used with the surface mounting frame in surface mounting installations. The back box shall be 20-gauge galvanized steel and shall contain knockouts through which power leads are brought.

K. Front panel: The front panel shall be of the bar grille type and shall be constructed of 16-gauge cold-rolled steel, welded into a uniform grille to direct the warmed air toward the floor. The front grille shall be surrounded by a decorative satin-finish aluminum “picture” frame.

L. Three-piece design: The heater shall be made up of a back box, a heater assembly and a front panel.

2.3 ELECTRIC CEILING HEATER (**ECH-1.01**)

A. Basis of Design:

1. Electric ceiling heaters shall meet model number, types, sizes, capacities and electrical characteristics as indicated on the contract drawings.
2. Basis of design shall be model number “FFCH-548” manufactured by Berko, comparable products manufactured by Brasch, Chromalox, Marley, Trane and Qmark shall be submitted for review as comparable products.

B. The heating equipment shall include an electric, ceiling-mounted type FFCH Series 500 fan-forced air heater suitable for large area heating. The heater shall be designed for recess mounting.

C. Heater Section: The heater section shall consist of a 20 gauge steel chassis on which are mounted the heating elements, fan motor and blade, fan control, thermal cutout and 3-pole contactor. Heater section shall be completely prewired.

D. Heater Elements: The heating elements shall be guaranteed for five years and shall be of non-glowing design consisting of 80/20 NiCh resistance wire, enclosed in a steel sheath,

to which steel plate fins are brazed. The elements shall cover the entire air intake area to ensure uniform heating of all discharged air.

E. Motor and Controls: The fan motor shall be impedance-protected, permanently lubricated and with totally-enclosed rotor. Fan control shall be bi-metallic, snap-action type and shall activate fan immediately and continue to operate the fan after the thermostat is satisfied and until all heated air has been discharged. Thermal cutout shall be bi-metallic snap-action type designed to automatically shut off heater in the event of over-heating and reactivate the heater when temperature returns to normal.

F. Operational Controls: Thermostat, disconnect switch, and all interlock relays shall be installed within the heater enclosure.

G. Recess Enclosure: The back box shall be designed for duty as a recessed rough-in box in masonry, T-Bar, or frame ceiling construction. The back box shall be 20 gauge galvanized steel and shall contain knockouts though which field wiring leads are brought. Enclosure to recess into a maximum 7 inches of ceiling space. The louvered recess faceplate shall be of 20 gauge cold rolled steel, phosphatized, then electrostatically painted Navajo white by a baked enamel process.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 Section: “Administrative Requirements”: Coordination and project conditions.

B. For recessed units, verify recess dimensions are correct size.

C. Verify wall construction is ready for installation.

D. Verify concealed blocking and supports are in place and connections are correctly located.

3.2 INSTALLATION

A. Protect coils to prevent damage to fins and flanges. Comb out bent fins.

B. Wire electric duct coils. Refer to Division 26.

C. Install equipment exposed to finished areas after walls and ceilings are finished and painted. Avoid damage.

D. Protection: Install finished cabinet units with protective covers during remainder of construction.

E. Unit Heaters: Hang from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

F. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Install electrical wiring in accordance with manufacturer's submittals and Division 26.

G. Install Work in accordance with all applicable codes, standards and local authorities having jurisdiction requirements.

3.3 CLEANING

A. Division 01 Section: “Execution and Closeout Requirements”: Requirements for final cleaning.

B. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

C. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

D. Install new filters.

3.4 COMMISSIONING

A. Provide support for Commissioning Activities and Functional Performance Testing as outlined in specification Division 01 Section “Commissioning”.

B. Contractor shall provide copies of final reports to the Commissioning Agent (CxA) for review and inclusion with final Cx project documentation as applicable

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections, apply to this and other sections of Electrical and Special Construction Divisions.

1.2 SUMMARY

A. This section includes qualification requirements of the installer and suppliers, submittal procedures, record keeping, required testing and general electrical procedures.

B. Section Includes:

1. Additional submittal requirements.
2. Installer and product requirements.
3. Identification of equipment.
4. Firestopping for electrical installations.
5. Supporting devices for electrical components.
6. Concrete equipment pads.
7. Fuses.
8. Equipment connections.
9. Cutting and patching for electrical construction.
10. Touch up painting.
11. Electrical demolition.
12. Project conditions.
13. Additional warranties.
14. Utility coordination.

C. Related Sections:

1. Section “Vibration & Seismic Controls for Electrical Systems” for special project conditions, supporting products and requirements.
2. Section “Low Voltage Electrical Distribution” for concrete pad requirements.
3. Section “Low Voltage Transformers” for concrete pad requirements.

D. Products installed but not supplied under this Section:

1. Provide electrical connections and materials required for the installation and connections to products of other section, including but not limited to:
   a. Countertops, Casework & Cabinets.
   b. Elevators.
   c. Conference Room or other area A/V equipment including projectors, screens, wall monitors, etc.
   d. Break room and lounge appliances.
   e. Magnetic door holders.
   f. Electrically locked doors, door strikes, maglocks, etc.
   g. Motorized and automatic doors, push plates, sensors, etc.
   h. Motorised garage doors, pushbutton controls, etc.

2. Coordinate electrical connections with installation requirements and manufacturers' nameplates and written instructions.
3. Verify equipment nameplates and connection requirements prior to rough in.

E. Permits and Fees:

1. Apply, pay for and secure all permits, required by the Authorities Having Jurisdiction prior to start of work, in accordance with contract General Conditions and Division 01.
2. Deliver all certificates to the Owner prior to final acceptance of work.

F. Conflicts:

1. Where variances occur within drawings and/or specifications, procedures of the General Conditions shall be followed.
2. In cases where clarification is not requested, provide the item or arrangement of better quality, greater value, or higher cost in the Contract Price.
3. Bring to the Architect's attention, any field conflicts or existing conditions, which prevent the intended work as designed.

1.3 ACRONYMS

A. The following acronyms are used throughout the Electrical Division specifications, defined as follows:

1.	AASHTO	American Association of State Highway and Transportation Officials
2.	ADA	Amer. With Disabilities Act
3.	ANSI	American National Standards Institute
4.	ASME	American Society of Mechanical Engineers
5.	ASTM	American Society for Testing and Materials
6.	IBC	International Building Code
7.	IEEE	Institute of Electrical and Electronics Engineers
8.	ETL	Electrical Testing Laboratory
9.	FM	Factory Mutual Research Corporation
10.	NEC	National Electrical Code
11.	NECA	National Electrical Contractors Association
12.	NEMA	National Equipment Manufacturers Association
13.	NESC	National Electrical Safety Code
14.	NETA	National Electrical Testing Association
15.	NFPA	National Fire Protection Association
16.	NLPI	Lightning Protection Institute
17.	UL	Underwriter's Laboratories

1.4 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term product includes the terms material, equipment, system, and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, which is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another

project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.

3. Comparable Product: Product that is to be demonstrated and approved through the submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Substitutions: Changes proposed by Contractor in products, materials, equipment, and methods of construction required by the Contract Documents.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is the only named manufacturer or is the “first” named manufacturer, or is accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimensions, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner

E. Extended Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.5 SUBMITTALS

A. General: Submit each item in this Section according to the conditions of the contract and Division 01 Specification Sections.

B. Comply with Division 01 Section "Submittal Procedures".

C. General:

1. Shop Drawings
2. Product Data
3. Installation and Coordination Drawings
4. Record Documents
5. Operation and Maintenance Manuals
6. Construction Phasing and Outage Schedule
7. Emergency power and temporary power plans for existing building.

D. Submittal Deviations from Contract Documents:

1. Submittals shall explicitly identify any deviations from the drawings, specifications or design intent, including, but not limited to:
   a. Different products used.
   b. Products used in different locations from where shown or specified.
   c. Changes to intended application, location, etc.
   d. Changes to capacity, rating or size.
   e. Differences in physical sizes, dimensions and/or weights which will create installation, clearance or access problems or Code violations.
2. Contractor shall clearly and specifically identify each such deviation, substitution or change to the contract documents to Architect’s attention via note, clarification,

etc. It is NOT considered to be explicitly identified simply by showing a device on the plans or including a product page in the submittal.

E. Basis-of-Design Comparable Products Submission:

1. Contract Drawings are based on only the named “Basis of Design” products.
2. Engineer has not verified that any Comparable Products by manufacturers other than the “Basis of Design” equipment will properly fit, perform or meet the design intent and contract documents.
3. Contractor must verify sizes, ratings, dimensions, clearance requirements, weight, etc. of any/all manufacturers. Contractor is responsible for the fitment of their proposed equipment, and resulting impacts to other construction or disciplines, Code compliance, etc.
4. Document each Submittal, Comparable Product or Substitution request with supporting data substantiating compliance of proposed product with Basis-of-Design product.

F. Product Substitutions: Comply with all requirements of Division 01.

G. Comparable Products Submission:

1. Document each request for a proposed comparable product with supporting data substantiating compliance of proposed product with Basis-of-Design product.

H. Coordination of Submittals: Coordinate Electrical and Special Construction Division submittals with those of all other Divisions. Also, review submittals of all other disciplines’ submittals specifically for proper coordination of electrical circuits, including locations, ratings and types of required connections. Coordinate all electrical provisions and rough-ins with all other project disciplines.

I. Electrical Division additional submittal requirements: On projects where Div 01 does not specify otherwise, and where Owner does not have a defined submittal procedure, provide submittals, as follows. Where Div 1 specs are applicable, also provide the following.

1. Clearly identify all submittals, as follows:
   a. Number each submittal starting with the specification section associated with the product(s). Each successive product from same spec section shall utilize a sequential suffix (i.e. -01, -02).
   b. Following each number, include specific English name of each product. (i.e. Spec Section # - Panelboards).
   c. Do not combine product data from different spec sections into a single submittal package as this may prevent approval of one product due to resubmission requirement of another.
   d. Provide catalog spec and/or data sheets to completely describe proposed equipment. A product model number alone, with no supporting description or data will not be approved.
   e. Where numerous models or product numbers appear, clearly indicate the exact type, model number, size, options, and special features of the proposed item.
   f. Factory order forms showing only required capacities, are not acceptable.
   g. Identify all options furnished to meet specifications.
   h. The Architect shall not select or mark equipment ratings and/or options. Submittals not properly and specifically marked shall be returned without

review.

2. Identify any discrepancies in the contract documents affecting submittals and seek clarification.
3. Product data PDF's shall contain only product cut sheets, data sheets or catalog pages as pertain the proposed products. Use of manufacturer's PDF catalog pages shall be limited to only those pages relevant to the proposed products. Submittals consisting of entire catalogs of other products, irrelevant data, etc. shall be returned without review.
4. Submit all related product drawings, data sheets, layout drawings, etc. for each system or product in a single submittal. Do NOT submit product data, wiring diagrams and calculations for one product submittal as multiple separate submittals or PDF's.

J. Product Data:

1. Manufacturer's specifications, data sheets.
2. Catalog cuts.
3. Dimensional drawings.
4. Installation Instructions.
5. Wiring & connection diagrams.
6. Capacity ratings, performance curves.
7. Information required indicating contract compliance.
8. Clearly indicate the exact size or rating proposed.

K. Shop Drawings:

1. All specially fabricated items.
2. Modifications to standard items.
3. Specially designed systems or products.

L. Closeout Submittals: Submit in accordance with the General Conditions and Division 1 requirements.

1. Electrical Division Operation and Maintenance Manuals:
   a. Arrange material in sections according to Electrical Division spec sections.
   b. Include a cover sheet, which contains the name and phone number of the Installer, Distributor, Supplier, Local Service Company, etc. for each system or product group.
   c. O & M Manuals shall also include the following:
   d. Material and Equipment List.
   e. Copies of all approved submittals.
   f. Acceptance Test Reports (ground resistance, etc.)
   g. Manufacturer's Product Warranties.
   h. Factory data sheets, wiring diagrams, etc.
   i. Spare parts lists.
   j. All operation and instruction papers.
   k. Maintenance schedules.

2. Record Drawings:
   a. During construction, maintain drawings on blue or black line white prints.
   b. Record all changes and alterations in red ink.
   c. Record the installed electric feeders, equipment, etc.
   d. Actual installed locations of panels, switchboards, transformers, etc.
   e. All feeders overhead, underslab or in chases.

f. Pullboxes, handholes and splice box locations.
g. All underground feeders, conduit, ducts, cables, handholes, manholes, etc. with installed dimensions from permanent construction elements.
h. All modifications, changes, deletions or additions made during construction.
i. Submit one (1) complete set of contract drawing prints with "as-built" information neatly recorded in RED at project completion. Submit files in PDF format.

M. Required Submittals: Submit the following items, as a minimum requirement for this project:

1. Section “Common Work Results for Electrical”:
   a. Material and Equipment List
   b. Coordination Drawings for Electrical, Mechanical, IT Rooms, etc.
   c. Electrical Installer Qualifications
   d. Fire Stop materials
   e. Access Panels
   f. Copies of Electrical Inspection Reports
   g. Equipment Acceptance Test Reports
   h. Completed Punchlist with contractors’ initials/dates
   i. Record drawings
   j. O&M Manuals
2. Section “Low Voltage Electrical Power Conductors and Cables”:
   a. Building wires and conductors.
   b. Cables and cable assemblies.
   c. Splices and connectors.
   d. Acceptance testing of conductors, feeders, etc.
3. Section “Grounding and Bonding for Electrical Systems”:
   a. Ground rods
   b. Ground buses
   c. Exothermic Welds
   d. Ground Resistance testing
4. Section “Raceways and Boxes for Electrical Systems”:
   a. Conduits.
   b. Surface raceways.
   c. Floor mounted devices.
5. Section “Underground Ducts and Raceways for Electrical”:
   a. Conduits.
   b. Handholes
   c. Utility Marker Tape
6. Section “Vibration and Seismic Controls for Electrical Systems”:
   a. Engineering calculations/design for supports/bracing
   b. Product data
7. Section “Overcurrent Device Coordination, Short Circuit & Arc Flash Studies”:
   a. Short-circuit, coordination & arc flash studies -draft.
   b. Short-circuit, coordination & arc flash studies – revision(s) as required.
   c. Tabulations of circuit breaker, fuse and device ratings
   d. Protective device time current coordination curves.
   e. Fault current calculations.
   f. Arc flash incident energy and flash protection boundary calculations
   g. Recommendations for system improvements, where needed
   h. One-line diagram
   i. Arc flash labels.
8. Section “Low Voltage Electrical Distribution”:

a. Current Transformer cabinets.
b. Enclosed and automatic circuit breakers.
c. Elevator Main Line Disconnects.
d. Surge Protective Devices (SPD)
e. Submetering & data collection system.
f. Safety Disconnect Switches.
g. Lighting contactors
h. Panelboards.
i. Generator Docking Stations.
j. Post Installation acceptance testing reports.

9. Section “Low Voltage Transformers”:
   a. Product data for transformers and all accessories/components
   b. Elevation and plan view drawings.
   c. 1-line diagram showing all internal/external components, connections, accessories, etc.
   d. Post Installation acceptance testing report.
10. Section “Wiring Devices”:
   a. A/C switches.
   b. Receptacles.
   c. Connectors.
   d. Device plates and covers.
11. Section “Low Voltage Controllers”:
   a. Thermal manual motor starter switches.
   b. Motor starters.
12. Section “Photovoltaic Collectors”:
   a. Product Data: For each type of product.
   b. Shop Drawings: For PV modules.
   c. Calculations for: peak energy output; yearly production (kw-hrs); PV string voltage drop; PV string, combiner and inverter maximum open circuit voltages, etc.
   d. Plans, elevations, sections, and mounting details.
   e. Diagrams for power, signal, and control wiring.
13. Section “Packaged Generator Assemblies”:
   a. Product data for Engine-generator assembly and all accessories
   b. Service platform and stairs: plans elevations and details.
   c. Post installation startup test report.
   d. Post Installation Load Test report.
14. Section “Transfer Switches”:
   a. Product Data for transfer switches, accessories, and components.
   b. Dimensional drawings.
   c. Startup and initial programming reports.
   d. Post Installation acceptance testing reports.
15. Section **“**Lightning Protection for Structures”:
   a. Roof plan showing system components and layout
   b. Product data including Air terminals conductors, connectors, fasteners, sealants.
   c. Post Installation Ground Resistance Test Report
16. Section “Lighting”:
   a. Product data for all Individual lighting fixtures.
   b. LED drivers.
   c. Occupancy sensors.
   d. Line or low voltage room lighting control devices and systems.
   e. Lighting poles.
   f. FC calculations
   g. Wiring diagrams for lighting controls, etc.

17. Section “Emergency Responder Radio Repeater System”:
    a. Bill of materials showing quantities and model numbers.
    b. Manufacturer's product data on all proposed equipment.
    c. Floor plans showing location of amplifiers, antennae, cable routes, etc.
    d. System wiring schematics.
    e. Scaled plans and elevations,
    f. System design and calculations.
    g. Pre-system and post-installation radio signal strength surveys.
    h. FCC Licensing data.
    i. Copy of AHJ Final Inspection / Approval.

1.6 ELECTRONIC AUTOCADD DOCUMENTS

A. Requests for electronic Autocadd documents will be accommodated to the contractors and installers upon receipt of Bowman’s Electronic Document Release Form. Only floor plans and part plan drawings shall be provided.

1.7 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms “Listed and Labeled”: As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.

B. Underwriter’s Laboratory (UL) Requirements: All equipment containing electrical components and provided under electrical, mechanical, or other Divisions shall bear the Underwriter’s Laboratory (UL) label, as a complete packaged system.

C. Field Certifications and Labeling:

1. Equipment not provided with a UL label shall be tested in the field certified and provided with a listed label at the installer’s expense.
    a. Field testing shall be performed by a testing agency approved by the authority having jurisdiction.
    b. Provide services of a UL recognized, independent Electrical Testing Laboratory (ETL) to provide field inspection and testing. Provide an ETL Label on all such equipment as proof of satisfactory inspection.

D. Fire Safe Materials: Unless otherwise indicated, materials shall conform to UL, National Fire Protection Agency (NFPA) or American Society for Testing and Materials (ASTM) standards for fire safety with smoke and fire hazard rating not exceeding flame spread of 25 and smoke developed of 50.

E. Install all components and equipment per manufacturer’s written instructions.

F. Installer Qualifications:

1. Provide proof of qualification. Submit the following, when requested:
    a. Five (5) comparable completed projects.
    b. Reference letters from minimum of three (3) registered professional engineers, general contractors, or building owners, explaining proficiency, quality of work, or other attribute on projects of similar size or

substance.
c. Copy of Master Electrician's License.
d. Local or State license.

2. Electrical installer shall utilize a fulltime project foreman in charge of all electrical work.
a. Fully qualified and experienced in such work.
b. Available on site at all times during construction.
c. All communication shall be through this person.

G. Installation Quality: In accordance with listed Codes, recognized trade organizations and standards.

1.	ADA	Americans with Disabilities Act Accessibility Guidelines
2.	ANSI/EIA/TIA	American National Standards Institute
3.	ASME	American Society of Mechanical Engineers
4.	IEEE C2	National Electrical Safety Code
5.	NEMA	National Equipment Manufacturers Association
6.	NECA	National Electrical Contractors Assn Standards of Installation
7.	NEMA	National Electrical Manufacturer’s Association
8.	NETA	National Electrical Testing Association
9.	UL	Underwriter’s Laboratories

H. Comply with the latest version of following Codes, Standards and regulations as adopted by the Authority Having Jurisdiction, unless otherwise specified.

1. NFPA
2. NFPA 70 “National Electrical Code”.
3. IBC
4. IECC
5. COMAR (Code of Maryland Regulations).
6. State of Maryland Fire Prevention Code
7. Baltimore County Electrical Code
8. Local Amendments to the above Codes

1.8 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Arrange for proper shipping methods for all materials.
2. Provide for handling and unloading of all materials at site or at offsite storage facility.
3. Provide for proper transportation between offsite storage and project site.
4. Provide rigging and other handling services, when necessary.

B. Storage and Protection:

1. Store all materials in dry, heated areas, unless manufacturers permit other storage environments.
2. Store equipment according to manufacturers’ written instructions.
3. Protect materials subject to damage or corrosion from excessive moisture.
4. Protect equipment subject to damage from excessive heat or sunlight in ventilated environments.
5. Protect equipment from dripping, splashing or sprayed materials.

C. Repair and Replacement of Damaged Equipment: Repair equipment damaged as a

result of improper storage or handling at no expense to Owner. If, in the opinion of the Architect, equipment cannot operate properly after repairs are made, replace at no cost to Owner.

1.9 PROJECT CONDITIONS

A. Occupied Building: Allowances shall be considered and included in bids for performing work within existing, occupied buildings. Certain functions, i.e. core drilling, may be limited in their allowed times, due to disturbance of other occupants. Work occurring within occupied areas may require scheduling of work during unoccupied periods.

B. Access Delays: Allowances shall be considered and included in bids for delays upon entering/exiting existing police station facilities, controlled access areas, etc.

C. Prisoner/Prisoner Detention Areas: Project includes work and equipment to be installed in detention environments. All materials and methods shall be suitable for such “Maximum Security” environment. This includes requirements for heavy duty equipment construction, tamperproof equipment and hardware and special construction tolerances/workmanship, as specified herein.

1.10 SEQUENCING

A. General Sequencing:

1. Coordinate electrical work with other trades based on phasing and sequence of construction, as identified elsewhere in the contract documents.
2. Provide all scheduling, phased installation, etc. to coordinate with overall phasing plans.

B. Electrical Division Sequencing, Coordination, and Integration:

1. Coordinate systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in building structure during progress of construction to allow for electrical installations.
4. Coordinate the installation of required supporting devices, sleeves and conduit to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Make provisions for large equipment requiring positioning prior to closing in the building.
6. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
7. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
8. Coordinate requirements for access panels and doors where electrical items requiring access are concealed behind finished surfaces.

1.11 COMMISSIONING

A. Provide post-installation commissioning for particular products and systems, as specified:
1. Cx requirements within individual Division 26 specification sections.

2. Division 26 spec section “Commissioning of Electrical Systems”

B. Per 2023 NEC 700.3(A) and 701.3(A), provide for commissioning of the Emergency Power System in compliance with NECA 90 “Standard for Commissioning Building Electrical Systems.” Refer to Commissioning specifications, listed above for additional requirements. Per NEC, the AHJ shall be present to witness the commissioning and functional testing of the systems.

1.12 WARRANTY

A. Provide warranty in accordance with the General Conditions and Division 01 requirements, and as stated herein.

B. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

C. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include project-specific information and properly executed.
2. Refer to other specification Sections for specific content requirements and particular requirements for submitting special warranties.

D. Special Warranties: Provide additional product and/or installation warranties for particular products, as specified within individual specification sections.

E. Obtain all warranty papers and records from the Original Equipment Manufacturer (OEM) according to their warranty policy and deliver the same to the Owner. Fulfill all the OEM's requirements to validate the warranty at conclusion of project. Include copies of warranty papers with Closeout Submittals.

1.13 MAINTENANCE

A. Extra Materials: Provide extra, loose and/or spare materials, as required by individual specification sections.

B. Maintenance Service: Provide preventative maintenance services or maintenance services as required by individual specification sections.

PART 2 PRODUCTS

2.1 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with Contract Documents, which are undamaged and new at time of installation.

1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for complete installation and intended use and effect.
2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Where products are accompanied by the term as selected, Architect will make selection.

4. Where products are accompanied by the term match sample, sample to be matched is Architect's.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. General Compliance Requirements: Compliance requirements for individual products, as indicated in Contract Documents, are multiple in nature and may include generic descriptions, performance requirements, compliance with reference standards, conformance with graphic details and other similar forms and methods of indicating requirements, all of which must be complied with.

C. Procedures for Selecting Products: Contractor's options for selecting products are limited by Contract Document requirements and are not controlled by industry traditions or procedures experienced by Contractor on previous construction projects.

D. Products specified by Reference Standards, Codes and Regulations: Select from among products, which can be shown to comply to, referenced documents.

E. Products specified by Naming Products and Manufacturers: Select from among products listed.

F. Products specified by Naming One Manufacturer's Product as the Basis-of-Design with Reference to Other Manufacturers: Select either the specified Basis-of-Design product or an approved comparable product by one of the other named manufacturers.

1. Comply with provisions in Comparable Products Article to obtain approval for use of a comparable product by one of the named manufacturers.

G. Products specified by Naming One Manufacturer's Product and Indicating Option of Selecting Comparable Products by stating or Approved Equivalent or similar language: Select either the specified product or an approved comparable product.

1. Comply with provisions in Comparable Products Article to obtain approval for use of an unnamed comparable product by another manufacturer.

H. Visual/Aesthetic Match Requirements: Certain products may have been specified or scheduled to achieve a particular appearance, shape, color, etc. This may apply to light fixtures and other products. Where specs or schedules indicate “Color by Architect”, a final color selection shall be made from the product manufacturer's product line that includes both standard and premium colors.

2.2 COMPARABLE PRODUCTS

A. Where Basis-of-Design products are specified by name, submit the following, in addition to other required submittals, to obtain approval of a comparable product by one of the named manufacturers:

1. Evidence that the proposed comparable product does not require revisions to the Contract Documents and is consistent with the Contract Documents.
2. Documentation that the proposed comparable product will produce the indicated results and is compatible with other portions of the Work.
3. Detailed comparison of significant qualities of proposed product with the Basis-of-Design product in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, serviceability, visual effect, and specific features and requirements indicated.

4. Evidence that proposed product provides specified warranty.
5. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
6. Samples, if requested.

2.3 IDENTIFICATION PLATES

A. General:

1. Dimensions: Minimum of 1" H x 2 1/2" W.
2. Lettering: All capitals, 1/4"H x 1/16" stroke. Indicate circuit number, device (EXHAUST FAN 1, PUMP No. 2, etc.).
3. Indoor Tags:
   a. Laminated phenolic plastic.
   b. White with black engraved letters.
   c. Stainless steel attaching screws.
4. Outdoor Tags:
   a. Stainless steel tag.
   b. Stainless steel attaching screws.
5. Handhole Cable Tags:
   a. Stainless steel tag.
   b. Nylon cable ties.

2.4 LOW VOLTAGE TERMINAL IDENTIFICATION

A. Permanent identification in accordance with the manufacturer’s shop drawings or product data.

B. Identify all control cables and wires:

1. All indoor locations:
   a. Nylon, self-adhesive.
   b. Factory printed with permanent numerals/letters on white background.
2. LEM Wire Markers, or comparable product by 3M or Panduit.

2.5 FIRE STOPPING MATERIALS

A. General:

1. UL 1479 Listed, Fire Tests For Through-Penetration

B. For large openings:

1. 2-part, RTV silicone elastomer expanding foam.
2. 3-4X expansion.
3. STI Pensil Series PEN Foam, Dow Corning Fire Stop Foam, or comparable product by 3M.

C. For small openings and voids (less than 1"):

1. 1-part, Intumescent sealant.
2. Permanent, flexible and resilient.
3. 5X free expansion.
4. Red color for instant identification as fire barrier.
5. 4-hour fire rating.

6. STI Spec Seal Intumescent Sealant, 3M Fire Barrier Sealant, or comparable product by Dow.

2.6 TAMPER PROOF HARDWARE

A. Provide tamper proof hardware for all panels, devices, pull boxes, junction boxes, cover plates, light fixtures and any other equipment or items accessible to prisoners, as indicated on the drawings. Equipment requiring tamperproof hardware, includes but is not limited to:

1. Junction/pull boxes
2. Receptacles, switch, or outlet coverplates
3. Light fixtures

B. Hardware shall use standard manufactured design, using center-pin torx screws.

C. Provide Owner with two (2) sets of each size of hardware wrenches, drivers, etc. needed for all hardware sizes installed on this project.

2.7 SPECIAL TOOLS & OPERATING ACCESSORIES

A. Wherever any products provided under this Division have tamperproof, special or restrictive hardware, as specified or where provided from the manufacturer as standard or optional construction, provide a minimum of two (2) matching tools, bits, sockets, etc. needed for operation and/or access to such items. This shall include, but is not limited to:

1. Tamperproof screws, bolts, etc. on devices, enclosures, covers, etc.
2. Any other special tools which are unique to that product.

2.8 POWER DISTRIBUTION BLOCKS

A. For connections and/or taps made within auxiliary wiring troughs, junction boxes, etc. Install within wiring troughs, with all necessary clearances around blocks, with required wire bending radii.

1. Plated aluminum terminal blocks.
2. Lexan, fiberglass, or other insulating material molded around to insulate block from mounting surface and provide side protection from adjacent wiring and surfaces.
3. UL Listed for 600 volts.
4. 1, 2, 3 or 4 terminal blocks on a common insulated mounting, as required.
5. Uninsulated terminal block for ground conductors to ground mounting surface, trough, etc.
6. Hex drive set screws for conductor connections.
7. Suitable for copper conductors.
8. Ilsco type PDB, or comparable product by Littelfuse or Marathon.

2.9 LOW VOLTAGE FUSES (0 - 600 VOLTS)

A. UL 248, “Low Voltage Fuses” Listed, 250 or 600 volt, ratings per drawings or protected equipment manufacturer's nameplate.

B. Class RK-1:

1. Current limiting, dual element, time delay.

2. Interrupting rating of 200,000 amps rms symmetrical.
3. Class R rejection clips.
4. Buss Low Peak LPS-RK (600 V) or LPN-RK (250 V), Littlefuse LLSRK (600 V) LLNRK (250 V).

C. Blown Fuse Indication:

1. For all fuses 100A and larger.
2. Automatic indication of blown (open) fuse.
3. Viewing window or indicating light.
4. Buss SAMI fuse covers or Littelfuse Indicator.

D. Spare Fuses:

1. Provide spares for each installed type and rating.
2. Minimum of (3) for 1-9 installed, (6) for 10-18 and (10) spares where more than 18 are installed.
3. Deliver to OWNER at completion of contract.

2.10 SUPPORTING DEVICES

A. Channel and angle support systems, hangers, anchors, sleeves, brackets, fabricated items, and fasteners are designed to provide secure support from the building structure for electrical components.

1. Material: Steel, except as otherwise indicated, protected from corrosion with zinc coating or with treatment of equivalent corrosion resistance using approved alternative finish or inherent material characteristics.
2. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel, except as otherwise indicated.

B. Steel channel supports have 9/16-inch diameter holes at a maximum of 8” on center, in at least one surface.

1. Fittings and accessories mate and match with channels and are from the same manufacturer.

C. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps or "click"- type hangers.

D. Sheet-Metal Sleeves: 0.0276-inch or heavier galvanized sheet steel, round tube, closed with welded longitudinal joint.

E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

F. Expansion Anchors: Carbon-steel wedge or sleeve type.

G. Toggle Bolts: All-steel springhead type.

H. Powder-Driven Threaded Studs: Heat-treated steel.

2.11 CONCRETE EQUIPMENT PADS

A. Materials:

1. Interior Pads: 3000 PSI concrete at 28 days.
2. Exterior Pads: 3500 PSI concrete at 28 days; air entrained mix.
3. Steel mesh or rebar reinforcing, where required.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions:

1. Examine site and existing conditions prior to submitting bids.
2. Carefully examine proposed locations where work will occur in existing buildings and excavation near existing piping, conduit, cable, structures, etc.
3. Make required allowances for the conditions.
4. Request clarifications and or directions in writing, if required.
5. No allowance will be made for any errors, oversights or other negligence on the part of the Installer.

3.2 PREPARATION

A. Protection:

1. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
2. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

B. Construction Power:

1. Obtain and pay for temporary electrical service for construction power, trailers, etc.
2. Provide all underground and/or overhead equipment, transformers, overcurrent devices, wires, connections, etc. for obtaining power from utility company or Owner’s electrical lines.
3. Pay all charges for connections, accounts, metering and consumption charges for construction power.

C. Temporary Power:

1. Provide temporary power connections, transformers or generators for existing buildings during all outages.
2. Provide full power availability at all times unless directed otherwise by Owner.
3. Installer shall determine temporary power requirements of buildings in order to size temporary transformer or generator.
4. Remove all temporary power installations and connections after permanent power is established and/or prior to completion of project.

D. Interface With Site Utility Companies:

1. Contact MISS UTILITY prior to any excavation or underground work.
2. Contact serving utility companies immediately upon award of contract. Do not install related equipment until fully coordinated with appropriate utilities.
3. Provide all construction schedules, dates of requested services, outage windows, equipment locations, etc. necessary for utility work.

4. Contractor shall contact each serving utility company to schedule the performance of work by utility company(ies) when site conditions are ready (including raceways, handholes/manholes, backboards, etc. installed by contractors).
5. Electric Utility:
   a. Coordinate service entrance equipment and layout with power company prior to ordering or installing any service entrance equipment.
   b. Furnish and install all incoming raceway, metering cabinets and meter sockets.
   c. Coordinate cable, conduit, lug and C/T cabinet sizes for proper interface between utility owned/installed equipment and contractor-installed equipment.
   d. Provide concrete pad for utility company's transformer as required by Utility.

E. Utility Outages:

1. Schedule, stage, and perform all work such that interruptions to existing utilities and services are kept to a minimum.
2. No outages shall occur without prior written notification of Owner and/or User.
3. All required outages should be approved by the owner for optimum time scheduling.
4. Written notice of not less than 15 calendar days shall precede all power outages.

3.3 INSTALLATION

A. General Requirements:

1. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings.
2. Install work, generally as shown. Carefully examine all contract drawings and fit the work in each location without substantial alteration. Where departures are proposed or required, submit detailed drawings for acceptance.
3. Installation shall provide the maximum possible headroom where mounting heights or other location criteria are not indicated.
4. Install all items level, plumb, and parallel and perpendicular to other building systems and components, except where otherwise indicated.
5. Install equipment with proper service and access clearances as required by NEC and manufacturers' requirements.
6. Install such that future service or replacement shall not require interference with or removal of other installations.
7. Provide access to all equipment, splice boxes, switches, controls and other devices, without use of poles, ladders, scaffolding, etc.
8. Where equipment requiring access or service is concealed behind finished surfaces, provide access panel(s) or door(s).

B. Penetration of Fire Rated Construction:

1. Seal all in and around conduits and other electrical materials penetrating or creating openings in fire-rated, fire resistant or fire-stopped walls, ceilings, partitions and floors.
2. Contractor is responsible for the coordination, means & methods, and costs for all penetrations required for the installation of the work.

C. Miscellaneous Supports: Install metal channel racks for mounting cabinets, panelboards,

disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices except where components are mounted directly to structural features of adequate strength.

D. Sleeves: Install for cable and raceway penetrations of concrete slabs and walls, except where core-drilled holes are used. Install for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

E. Fastening: Unless otherwise indicated, securely fasten electrical items and their supporting hardware to the building structure. Perform fastening according to the following:

1. Fasten by means of wood screws or screw-type nails on wood; toggle bolts on hollow concrete masonry units; concrete inserts or expansion bolts on concrete or solid masonry; and by machine screws, welded threaded studs, or spring-tension clamps on steel.
2. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts, machine screws, or wood screws.
3. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or any other items.
4. In partitions of light steel construction use sheet-metal screws.
5. Drill holes in concrete beams so holes more than 1-1/2 inches deep do not cut main reinforcing bars.
6. Drill holes in concrete so holes more than 3/4 inch deep do not cut main reinforcing bars.
7. Fill and seal holes drilled in concrete and not used.
8. Select fasteners so the load applied to any fastener does not exceed 25 percent of the proof-test load.

F. Rough-in:

1. Contract drawings are generally diagrammatic.
2. Provide all offsets, bends, fittings and accessories, required to fit the work to the conditions, even though not specifically shown.
3. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
4. Refer to equipment specifications in all other Divisions for rough-in requirements.
5. The Owner, and/or his/her representative, reserves the right to make reasonable changes in location of equipment, conduit and wiring up to the time of rough-in or fabrication.

G. Cutting and Patching: Provide all cutting and patching in accordance with Division 1 and per the following requirements.

1. Perform all required cutting, fitting, and patching necessary for installation of Electrical Division work.
2. Cut, remove and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical systems and equipment as indicated on the drawings and specifications and other electrical items made obsolete by the new Work.

H. Tamper Proof Hardware:

1. Provide tamper proof hardware for all equipment, devices, cover plates, outlets,

and all other equipment provided under Electrical and Special Construction Divisions, where such equipment is accessible to prisoners at any time. Prisoner locations are indicated on the contract drawings.

3.4 CONCRETE EQUIPMENT PAD INSTALLATION

A. Interior Equipment Pads: Install concrete equipment (housekeeping) pads and bases for all transformers, switchgear, motor control centers, or other free-standing equipment.

B. Exterior Equipment Pads: Install concrete pads with foundations for all on-grade transformers, docking station, generators, control cabinets and other equipment.

C. Interior Pad Installation:

1. Steel dowel rods and bonding agent for anchoring to existing slabs.
2. 2" wider than equipment in all directions.
3. 1" x 45^{o} chamfer on all sides.

D. Exterior Pad Installation:

1. 4" wider than equipment in all directions.
2. 1" x 45^{o} chamfer on all sides.
3. Reinforce with steel mesh or rebar.
4. Provide minimum 30" deep (below grade) foundation on all sides.
5. Pour footings against undisturbed or compacted earth. Extend footings below the frost line for the location where installed.
6. Turn down rebar or mesh into all foundation walls.
7. Lowest side minimum of 6" above final grade.
8. Install vapor barrier between earth and concrete.
9. Provide PVC sleeves for all cables, conductors, grounding, etc. to penetrate pad.

3.5 CONSTRUCTION

A. Connections to Existing Work:

1. Keep all existing systems in operation during the progress of the work.
2. Provide temporary connections, where necessary to maintain continuous operation until the new systems and equipment are ready for operation.
3. Provide all necessary alterations, cuttings, fitting, etc. of existing work to make satisfactory connections between the new and existing work.
4. Leave the complete work in a finished and workmanlike condition.
5. Relocate existing equipment, conduits, wiring, etc. required. Make changes to existing work as may be required.

B. Interface with Other Work:

1. Mechanical and Plumbing Division Equipment and Systems:
   a. Provide the following for equipment furnished and/or installed under mechanical/plumbing Divisions, unless specifically noted otherwise:
   b. Line voltage power wiring connections to equipment such as motors, AHU’s, heaters, etc.
   c. Disconnect means per NEC.
   d. Manual or automatic starting contactors, starters, switches, etc.
   e. Provide power to all motor operated smoke dampers furnished and installed under other Divisions. Coordinate control operation through fire

alarm duct detectors, per Section “Fire Detection and Alarm”.

f. Mounting and connection of starters, speed controls, variable frequency drives and other such equipment furnished by mechanical Division.

g. Low voltage wiring between transformers and plumbing fixtures (faucets, toilets, urinals, etc.) for automatic controls, or line voltage wiring to fixtures, as required by equipment furnished under mechanical Divisions.

2. All electrical work performed under mechanical and/or plumbing Divisions shall be provided in accordance with electrical specification Divisions.
   a. Work performed/provided by mechanical Division shall include the following, unless specifically noted otherwise:
   b. All low voltage and line voltage control wiring including conduits, wiring, branch circuit breakers, etc.
   c. BMS or ATC system wiring and connections.
   d. Line voltage connections to all motor operated dampers, automatic valves, etc.
   e. Line voltage thermostats and associated wiring.
   f. All relays, contacts and other control equipment required for operation of mechanical Division equipment.
   g. Fuses within equipment, switches, control panels, etc. furnished from the factory with the equipment.
3. It is the intent to provide a complete and operational system. The work between mechanical and electrical Divisions is complementary and is meant to produce a single and operating system. Contractor shall make its own determination as to the distribution of responsibility among the various trades.
4. Equipment specified in other Divisions: Provide the following for equipment furnished and/or installed under Divisions, unless specifically noted otherwise:
   a. Kitchen, kitchenette, coffee or break room equipment and appliances: Provide all rough-ins, outlets, and/or hardwired connections.
   b. Elevators: Provide all power and low voltage rough-ins and connections to elevators and associated equipment, including:
      1) Elevator controller(s)
      2) Cab lights
      3) Fire alarm connections for shunt trip operations.
   c. Televisions and flat screen monitors: Provide power outlets and low voltage wiring backbox/conduit to all wall or ceiling mounted devices.

C. Routing of Electrical Feeds to Roof Mounted Equipment:

1. Conduit routing to roof mounted equipment shall be made to minimize the amount of conduit exposed above the roof.
2. Route conduit from building interior within roof curbs, where possible.
3. For condensing units and similar equipment, route conduit with refrigerant lines, using common penetrations through roof, coordinated with piping.
4. Where conduit must be run horizontally on roof surface, follow other piping, refrigerant lines, etc. Provide blocking, etc. to support conduit at regular intervals, per NEC. Secure conduit to blocks, supports, etc. to prevent movement.

D. Penetration of Waterproof Construction:

1. Minimize penetration of roofs, exterior walls and interior waterproof construction.
2. Provide necessary curbs, sleeves, shields, flashing, fittings and caulking to make the penetrations watertight.
3. All penetrations shall comply with roof manufacturer’s recommended materials and methods.

E. Penetration of Fire Rated Construction:

1. Seal all in and around conduits and other electrical materials penetrating or creating openings in fire-rated, fire resistant or fire-stopped walls, ceilings, partitions and floors.

3.6 DEMOLITION

A. Remove and dispose of all existing materials not required for re-use or re-installation.

B. Deliver on the premises, where directed, existing material and equipment which is to be salvaged and remain property of Owner.

C. All other materials removed shall become the property of the Contractor and shall be removed from the premises.

D. Remove conduit, hangers, supports, etc. to a point below the finished floors or behind finished walls and cap. Cut such items flush with masonry surfaces.

E. Outdoor/Exterior Demolition Work:

1. If cable cannot be removed due to collapsed duct, etc., cut cable at conduit entrance at each end and tag cable ends as "Abandoned Cable, Collapsed Duct" or similar reason.
2. Remove outdoor pad-mounted gear, including concrete pads, ducts, etc. down to 48" below final grade.
3. Remove overhead lines, poles, lights, etc. including service drops or laterals, conduit stubups, cable, pole base foundations and hardware.
4. Remove and/or relocate all lighting, poles, wires, conduits, base foundations, etc. associated with roads and fences being demolished or affected by such work.

3.7 RE-INSTALLATION

A. Where equipment is to be removed, and relocated or re-installed, provide careful removal of all items.

B. Temporarily store all materials and equipment, which are to be re-installed. Protect from damage. Replace any items damaged during removal, storage or re-installation.

C. Notify Owner immediately of any damaged or non-functioning equipment prior to removal or disconnecting. Document in writing or with photographs. Replace any damaged items for which Owner was not notified, at no cost to Owner.

3.8 REPAIR/RESTORATION

A. Restore all finishes, equipment and surfaces to original condition, where affected by the work. Provide the following, as applicable:

1. Replace damaged ceiling tiles.
2. Replace ceiling tiles where removal has left holes or cuts in original tiles.
3. Patch, repair and repaint all walls and surfaces cut, penetrated or otherwise disturbed by the work.
4. Patch holes and penetrations in masonry and plaster.
5. Provide suitable coverplates for all recessed backboxes of equipment removed

and not covered by new devices.

6. Provide larger trim or cover plates for new devices, where old backboxes, holes, etc. are not concealed by new work.
7. Patch finished surfaces and building components using new materials matching existing materials and experienced Installers qualified with the materials and methods required for the surface and building components being patched.

3.9 FIELD QUALITY CONTROL

A. General:

1. Provide all circuits free from ground faults, short circuits and open circuits
2. Perform tests specified or required to demonstrate that the work is installed and operating properly.
3. Where specific tests are required, give proper notice and perform all necessary preliminary tests to assure that the work is complete and ready for final test.
4. Other tests of a specific nature for special equipment shall be as specified under the respective equipment.

B. Inspections:

1. Schedule, pay for (as applicable) and attend all inspections required by the Authorities Having Jurisdiction.
2. Deliver all certificates to the Owner prior to final acceptance of work.
3. Notify Architect in advance of scheduled inspections.
4. An electrical foreman, superintendent or other supervisor shall be in attendance for all scheduled electrical inspections.
5. Schedule preliminary and rough-in inspections in a timely manner. Any work covered prior to any inspection in a manner which, in the inspector's opinion, precludes a complete inspection, shall be uncovered at the installer’s cost.
6. Uncover Work to provide for installation of ill-timed Work.
7. Disconnect installed work as specified for testing.

C. Acceptance Testing: Provide for acceptance testing of electrical equipment, as follows, and as required in other electrical Division specification sections.

1. Pay for and schedule all required acceptance testing.
2. Testing shall be by independent electrical testing contractor, licensed and certified by NETA.
3. Testing company shall be independent of installing company (i.e. no subsidiaries).
4. All tests shall be performed in accordance with the National Electrical Testing Association (NETA).
5. Notify Architect and Owner in advance of all testing.
6. Deliver all reports to Architect for approval.
7. Retest all failed equipment after adjustment, repairs, etc.
8. Provide all fuel, labor, etc. required for tests.
9. All costs associated with preparations for actual testing shall be borne by the installer.
10. Provide letter or statement on Testing Agency letterhead attesting to the satisfactory test results and suitability of the equipment to be energized and/or placed into service, as applicable. If testing reveals any problems or marginal results, the letter shall state these.

D. Replacement of Faulty Work or Materials:

1. Replace any equipment, which fails NETA test results at the direction of the Owner. All replaced equipment shall be retested at no cost to Owner.
2. Remove and replace all defective Work or materials.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Materials not installed per recognized standards, manufacturers' instructions, contract documents or design intent shall be removed and replaced when so directed by the Architect, at the Contractor's expense.

E. Project Punchout Inspection: Architect/Engineer will perform punch out reviews and will provide the Contractor with a list of punch list items to be completed before contract close out. Each and every punch list item shall be initialed and dated by the Contractor when the work is complete. The Architect/ Engineer will not perform any punch list verification until all items have been completed, initialed, dated and the list returned to the Architect/Engineer. If any items have been initialed as being completed by the Contractor and the Architect/Engineer determines that the work is not complete, the Architect/Engineer shall be reimbursed by the Contractor at his regular hourly rate for any and all items requiring revisiting of the site by the Architect/Engineer. Reimbursement shall be made by deducting the Architect/Engineer's fee from the Contractor's final payment.

3.10 ADJUSTING

A. General:

1. Lubricate, clean, adjust and test all equipment and systems in accordance with the manufacturer's instructions prior to initial operation.
2. Do not operate equipment unless proper safety devices and controls are operational.
3. Provide all maintenance and service for equipment, which is operated during construction, and protect the equipment.
4. Provide services of the manufacturer's factory-trained technicians to start up the equipment where required or specified.

3.11 IDENTIFICATION

A. Permanently identify all equipment in accordance with the project nomenclature.

1. Panelboards - identify panel as per contract, voltage, emergency or UPS power, and source panel as applicable.
2. i.e. PANEL RP1
   120/208 VOLTS
   EMERGENCY POWER
   FED FROM PANEL MDP
3. Starters, disconnects - identify fan, pump or load served and source circuit using contract nomenclature.
   i.e. EXHAUST FAN N0. 1
   Circuit RP1-1
4. Miscellaneous controls, terminal boards, etc.
   i.e. FIRE ALARM POWER SUPPLY
   Circuit ELSR-3
5. General purpose receptacles - identify branch circuit panel and circuit number on back of coverplate with permanent marker.

B. Provide manufacturer's Arc Flash Hazard Warning labels on all electrical switchboards, switchgear, panelboards, meter sockets, industrial control panels, etc. per NEC 110.16.

C. On all service equipment 1200 amps or more, provide a permanent label with the following information:
1. Nominal voltage
2. Available fault current at the service overcurrent protective device(s)
3. The clearing time of service overcurrent protective device(s) based on the available fault current at the service equipment.
4. The date the label was applied.

D. Where Selective Coordination is conducted for elevator OCPD's provide signage on device enclosure with the following label (per NEC 620.65):

CAUTION:
OVERCURRENT DEVICES IN THIS ENCLOSURE
ARE SELECTIVLY COORDINATED. EQUIVALENT
REPLACEMENT AND TRIP SETTINGS ARE REQUIRED

E. Identify all power conductors via colored insulation, or individual identification of phase wires with colored electrical tape at each junction box, panel or enclosure where conductors are visible. Color coding as listed below, on all building wiring and feeders:

1. 208/120-V System: As follows:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
   d. Neutral: White.
   e. Ground: Green.
2. 480/277-V System: As follows:
   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.
   d. Neutral: Gray.
   e. Ground: Green.

F. Handhole Cable Identification:

1. Identify all individual cables and phases in all handholes and manholes.
   a. Provide stamped stainless steel tags.
   b. Attach with nylon cable ties.
   c. Include feeder or circuit number, phase, etc.

3.12 LOW VOLTAGE TERMINATION IDENTIFICATION

A. Permanently identify all cables, wires, terminal boards, terminal blocks and other equipment in accordance with the manufacturer's shop drawings or product data.

B. Identify all control cables and wires:

1. All indoor locations:
   a. Length to permit a minimum of 2-3 revolutions around cable or wire.

C. Identification shall be applied to both ends of all control cables, wires, etc., within 2 inches of termination. Marking pens, embossed plastic tape markers or other temporary methods will not be acceptable.

3.13 EQUIPMENT MOUNTING

A. Disconnects & Control Equipment:

1. In sight of equipment served, with operating handle at 48-54" AFF.
2. As close as practical to motor, etc.
3. For large on-grade or roof mounted equipment, (i.e. DOAS, ACU's, etc.), mount to equipment housing or frames.

B. Allow for proper clearance of electrical items and equipment served.

3.14 DEMONSTRATION

A. Provide for equipment manufacturers' established representatives to demonstrate to Owner, the correct operation, safety, adjustments and maintenance of all electrical equipment and systems under this contract.

END OF SECTION

SECTION 26 05 19

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Section Includes:

1. Building wires and conductors.
2. Cables and cable assemblies.
3. Splices and connectors.
4. Acceptance testing of conductors, feeders, etc.
5. Load balancing.

B. Related Sections:

1. Section “Common Work Results for Electrical.”
2. Section “Grounding & Bonding for Electrical Systems” for coordination with grounding equipment and attachments.
3. Section “Raceways and Boxes for Electrical Systems.”

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):

1.	ASTM B3	Soft or Annealed Copper Wire
2.	ASTM B8	Concentric Lay Stranded Copper Conductors
3.	ASTM B174	Standard Specification for Bunch-Stranded Copper Conductors for Electrical Conductors
4.	ASTM B496	Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors
5.	ASTM B787	Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation

B. Underwriters Laboratory (UL):

1.	UL 4	Standard for Armored Cable
2.	UL 44	Standard for Thermoset-Insulated Wires and Cables
3.	UL 62	Standard for Flexible Cord and Cables
4.	UL 83	Thermoplastic-Insulated Wires and Cables
5.	UL 486A	Standard For Wire Connectors and Soldering Lugs for Use With Copper Conductors.
6.	UL 854	Service-Entrance Cables
7.	UL 910	Standard for Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air

8. UL 1424 Standard for Cables for Power-Limited Fire-Alarm Circuits
9. UL 1569 Standard for Metal-Clad Cables
10. UL 1479 Standard for Fire Tests of Through-Penetration Firestops
11. UL 1581 Reference Standard for Electrical Wires, Cables, and Flexible Cords

1.4 SUBMITTALS

A. Submittal Requirements of this section:

1. Building wires and conductors.
2. Cables and cable assemblies.

B. Product data, including construction, materials, performance data, etc.

C. Product Test Reports: Certified copies of manufacturer's design and routine factory tests required by the referenced standards.

D. Provide submittal data for each cable or conductor type.

1. To verify specifications have been met/exceeded.
2. Indicate UL listing for all products.

1.5 DELIVERY, STORAGE AND PROTECTION OF EQUIPMENT

A. Packing, Shipping, Handling and Unloading:

1. Deliver wire and cable according to NEMA WC-26, “Binational Wire and Cable Packaging Standard.”

B. Storage and Protection:

1. Store wires and cables out of rain.
2. Protect from physical damage.
3. Guard against nicks and scratches.

PART 2 PRODUCTS

2.1 METAL CLAD CABLE (MC)

A. Type MC metal clad cable for branch circuit applications.

1. Interlocking aluminum or galvanized steel armor.
2. THHN/THWN-2 insulation, 90^{o}C rated dry or wet.
3. Solid Conductors through #10 AWG: Soft or annealed per ASTM B3.
4. Stranded copper conductors for #8 AWG and larger, per ASTM B8 or B787
5. Phase identified conductors.
6. Insulated (green) equipment grounding conductor.
7. Internal, overall, non-metallic tape shield around all conductors.
8. UL 83, 1479, 1569, 1581 listed and tested per UL 2556. .
9. NEC 230, 300, 320, 330, 518, 520, 530, 605 and 645 compliant.
10. AFC MC, MC-Tuff, MC-Lite, or comparable product by Encore Wire, Southwire or Service Wire.

2.2 LUMINARY METAL CLAD CABLE (MC)

A. Type MC metal clad cable with insulated power and control conductors:

1. For use with 0-10V dimming controlled light fixtures, aa applicable.
2. Interlocking aluminum or galvanized steel armor.
3. Identifying blue spiral stripe or other approved markings along armor.
4. Solid copper conductors, white or gray neutral conductor.
5. Insulated (green) equipment grounding conductor.
6. Separate, #16 AWG, TFN-insulated purple/gray or colored control conductors.
7. UL 66, 83, 1479, 1569 listed and tested per UL 2556.
8. NEC 250, 300, 330, 392, 396, 501, 502, 503, 504, 505, 518, 520, 530, 645 and 725 compliant.
9. AFC Luminary Type MC Cables or comparable product by Southwire or Encore.

2.3 600 VOLT BUILDING WIRE

A. Copper Building Wire:

1. UL 44, 83 and 854 Listed, 600 volt, 90^{o}C:
2. All conductor sizes indicated are based on copper conductors.
3. Copper, stranded for #8 AWG, and larger.
   a. Concentric per ASTM B3, B8, B787.
   b. Compact round per ASTM B496.
4. #12 AWG minimum conductor size.
5. Thermoplastic Insulation:
   a. Interior #8 and smaller: THWN-2 or THHN
   b. Interior #6 and larger: THWN-2 or THW-2
   c. All exterior wiring: THWN-2 or THW-2
6. Provide wires as manufactured by Pirelli or comparable product by Service Wire Corp, Okonite Company, Encore Wire, Southwire, Carol Cable, OmniCable, or Regency.

2.4 SPLICES & CONNECTORS

A. Splices & Connectors for copper conductors:

1. Dry locations:
   a. #10 AWG and smaller: Insulated, solderless pressure type.
   b. #8 AWG and larger: Hydraulic pressure indentation type, Burndy "Hy-dent", or comparable product by T&B.
2. In handholes, manholes and direct buried locations:
   a. Silicone filled wire-nuts (King, or equal).
   b. Compound filled splice or connectors.
   c. Suitable for immersion in water.

2.5 UNDERGROUND LIGHTING FEEDER TAPS & CONNECTORS

A. Feeder Tap Connection for tapping underground copper conductors:

1. General Construction:
   a. 3:1 heat-shrink tubing, ANSI C119-1 Sealed Insulated Underground Connector Systems Rated 600 Volts.

b. Cross-linked polyolefin tubing, 600V insulation.
c. Flame retardant per IEEE 383, “Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections,” and ICEA S-19-81.
d. Hot melt adhesive to form watertight seal.

2. Straight Splice: To splice underground feeder with no reduction in conductor sizes:
   a. Hydraulic crimp sleeve, Burndy or equal.
   b. Heat shrink splice kit, Raychem WCSM Tubing:
3. Wye-Splice: To split underground feeder with no reduction in conductor sizes:
   a. Hydraulic crimp sleeve to match conductors, Burndy or T&B..
   b. Heat shrink splice kit, Raychem CRSM-CT Cable Tap Splice Kit, or comparable product by 3M or Ideal.
4. Tap-Splice: To splice underground feeder with no reduction in through-conductor size and smaller tap conductor:
   a. Hydraulic crimp sleeve to match main and tap conductors, Burndy or equal.
   b. Heat shrink splice kit, Raychem CRSM-CT Cable Tap Splice Kit or comparable product by 3M or Ideal.

2.6 LOW VOLTAGE CABLING

A. Cables for low voltage systems shall be as specified in other sections. If not specified, cables shall be per system manufacturer’s recommendations.

B. All low voltage cabling installed on this project shall be UL Listed, plenum rated cable, unless installed in metal conduit.

2.7 FIELD FABRICATED FOOD SERVICE EQUIPMENT CORDS

A. Provide field fabricated service cords for use connection of food service equipment, where indicated. Cords shall be used for separable connections of equipment to the building wiring system via twist-lock male equipment cord and plugs. Provide quantity per drawings.

1. Industrial duty, connectors as specified in Section “Wiring Devices”
   a. Twist-lock male connectors (type as required) for connection to wall or ceiling outlet.
   b. Standard (straight blade) female connectors (as required) for connection of equipment cord/plug.
2. Total length of 8-10 feet (coordinate exact length required prior to fabrication.)
3. Flexible SJOOW cord as specified elsewhere in this section.

PART 3 EXECUTION

3.1 APPLICATION

A. Service Entrance:

1. Type XHHW-2, THW-2 or THWN-2, copper conductor, in raceway.

B. Feeders:

1. Type THW-2, THHN/THWN-2, XHHW-2 copper conductor, in raceway.

2. Type MC, multi-conductor copper, 90C insulation, interlocked steel or aluminum armor sheath.

C. Emergency System Feeders & Engine Start Wiring Circuits (from Outdoor Generators to Emergency Equipment Room or ATS's):
1. Within Emerg Equip Room: THW/THWN-2 or RHH/RHW-2 copper conductors, 90C insulation in EMT conduit
2. Below Slab or Below Grade in Conduit: THW/THWN-2 or RHH/RHW-2 copper conductors, 90C insulation in PVC or RGS conduit.

D. Branch Circuits:

1. Type THHN/THWN-2, copper conductor, in raceway.
2. Type MC cable, copper conductor, 90C insulation.

E. Class 1 Safety Control Circuits:

1. Type THHN/THWN-2, copper conductor, in EMT, IMC, RGS or MC Cable raceway.

F. Class 1 Control Circuits:

1. Type THHN/THWN-2, copper conductor, in raceway.

G. Class 2 Control Circuits:

1. Power-limited cable, concealed in building finishes.
2. Type THHN/THWN-2, copper conductor, in raceway.
3. Type MC cable, copper conductors.

3.2 INSTALLATION

A. Install wires and cables as indicated, according to manufacturer's written instructions and the NECA "Standard of Installation."

B. Remove existing wire from raceways before pulling in new wire and cable.

C. Pull conductors into raceway simultaneously where more than one is being installed in same raceway.

1. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
2. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

D. Install exposed cable, parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.

E. Conductor Splices: Keep to minimum.

1. Install splices and taps that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
2. Use splice and tap connectors that are compatible with conductor material.

F. Terminations:

1. Terminate all conductors on distribution or utilization equipment as indicated.
2. Strip insulation per manufacturers' instructions.
3. Where equipment is not furnished with manufacturer's lugs, provide properly rated and sized lugs.
4. Where conductors have been oversized due to voltage drop or other requirements and cannot be accommodated under the standard lugs, contractor shall provide larger lugs to fit the conductors.
5. If lugs are not available to terminate the oversized conductors, contractor shall provide in-line (straight) splices at an approved location as close to the termination lugs as possible. Conductor size shall be reduced at the splice to the maximum size which the lug can accommodate.
6. In no case shall the conductors be reduced to a size rated less than the feeder or circuit overcurrent protection.
7. Removal of individual conductor strands is not permitted.
8. Where feeders contain conductor quantities which exceed the available lugs, contractor shall provide larger lugs to accommodate the additional conductors.
9. If lugs are not available the installed conductor quantity, contractor shall provide splices at an approved location (external to the equipment), but as close to the termination lugs as possible. Conductor quantities shall be reduced at the splice to the maximum number which the lug can accommodate.

G. Wiring at Outlets: Install with at least 12 inches of slack conductor at each outlet.

H. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, per manufacturer's published torque values or per UL 486A.

I. Use of Aluminum Conductors:

1. Not Permitted

J. AC & MC Cable Installation Requirements:

1. Installed concealed in finished areas.
2. Do not expose, except for final connections to modular furniture.
3. Group all AC/MC cables running together in bundles with nylon cable ties.
4. Route bundles neatly through ceiling cavities.
5. In high ceiling, or large plenum areas, install all AC/MC cables in groups, tight to underside of deck, within steel joist webbing.
6. Avoid constant changes in direction and elevation of bundles.
7. Install perpendicular and parallel to column lines, except for final separation from bundles.
8. Support bundles at regular intervals, per NEC, independent from ceiling hanger wires.
9. Provide adequate clearance above accessible ceiling tiles, minimum of 18."
10. Where circuits exit panelboards not located in electrical rooms or closets, conductors shall be installed in EMT conduit to a wire trough above the panel and finished ceiling, in an accessible location. AC/MC cable shall then be permitted to extend to the branch circuit devices.
11. Where circuits exit panelboards located in electrical rooms or closets, conductors shall be installed in EMT conduit to a wire trough outside the electric room, above the finished ceiling in an accessible location. AC/MC cable shall then be

permitted to extend to the branch circuit devices.

3.3 CONSTRUCTION

A. Generators, motors, vibrating or rotating equipment shall be stranded copper for all sizes. Solid wire not permitted.

3.4 FIELD QUALITY CONTROL

A. General:

1. Before making tests, complete all connections at panels, fixtures and other equipment.
2. Install fuses and have all wiring continuous from service equipment to utilization outlets.
3. Correct all undesirable ground, open and short circuit conditions.
4. Provide source of temporary power for making tests if normal building power is not available at the time.

B. Acceptance Testing: Take and record the following readings on systems 600 volts and below:

1. Provide megger tests of all feeder conductors, including ground conductors for the following:
   a. Service entrance conductors
   b. Panelboard and dry transformer feeder conductors
   c. Emergency system feeders including feeders between generators, docking station, ATS', panels, switchboards.
2. Indicate measured Ammeter readings on all phases and neutral of each feeder to indicate balance.
3. Ammeter readings on all phases of each poly-phase motor. Include nameplate full load current of each motor on data sheet.

C. Test Reports:

1. Certify that all overload devices have been set in accordance with data shown on the drawings and/or manufacturer's recommended setting.
2. Send final certified test reports and Certifications to Architect and Owner for approval, in accordance with Section "Submittals."

3.5 ADJUSTING

A. General:

1. Make and perform all adjustments after building distribution system and all branch circuits are installed and operating.
2. Make all ammeter measurements during regular working hours, when all personnel and equipment are working, to represent typical building conditions.

B. Feeder Balancing:

1. Make adjustments to branch circuit connections within branch circuit panelboards. Balance the load between each phase, as practicable.
2. After branch panels are balanced, perform balancing of phase loads on

distribution panels and switchboards.

3. Report ammeter readings before and after adjustments for each panel or switchboard.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Section Includes:

1. Solid grounding of electrical systems and equipment.
2. Basic requirements for grounding for protection of life, equipment, circuits, and systems.
3. Specialized grounding systems for specific installations.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Section “Underground Ducts and Raceways for Electrical.”
2. Section “Flagpoles” for grounding of flagpoles.
3. Section “Lightning Protection For Structures” for grounding, bonding and interconnection of components and systems.
4. Section “Elevators, Escalators and Materials Handling” for bonding and grounding requirements.
5. Section “Common Work Results for Electrical.”
6. Section “Vibration & Seismic Controls for Electrical Systems” for special project conditions, supporting products and requirements.
7. Section “Low Voltage Electrical Power Conductors and Cables” for grounding conductors and attachments.
8. Section “Packaged Generator Assemblies” for grounding, bonding and interconnection of generator and frames.
9. Section “Low Voltage Electrical Distribution” for grounding, bonding and interconnection of 600V class distribution equipment.
10. Section “Low Voltage Transformers” for grounding and bonding of equipment.
11. Section “Transfer Switches” for grounding, bonding and interconnection of neutral conductors within transfer switches.

1.3 SUBMITTALS

A. Submittal Requirements of this section:

1. Ground Rods.
2. Exothermic Weld materials.
3. Grounding/bonding clamps.
4. Main Electrical Grounding bus bars.
5. Telecomm MDF and IDF ground bus bars.

1.4 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

B. Installation Quality: In accordance with recognized trade organizations and standards.

1. NFPA 70, “National Electrical Code.”
2. UL 467, “Grounding & Bonding Equipment.”
3. IEEE.
4. ANSI/EIA/TIA 607, “Commercial Building Grounding and Bonding Requirements for Telecommunications.”

C. Conform to requirements of local power company, relating to grounding of utility company transformer pads.

1.5 SEQUENCING

A. General Sequencing:

1. Install all subsurface grounding equipment after completion of grading and excavations to avoid disturbance of components.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. A.B. Chance Co.
2. Cooper Power Systems
3. O-Z/Gedney Co.
4. Erico Cadweld
5. Harger

2.2 GROUNDING AND BONDING PRODUCTS

A. Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

B. Conductor Materials: Copper.

2.3 WIRE AND CABLE CONDUCTORS

A. General: Comply with Section “Low Voltage Power Conductors and Cables.” Conform to NEC, except as otherwise indicated, for conductor properties, including stranding.

B. Grounding Electrode Conductor: Stranded cable.

C. Insulated Ground Wire:

1. Minimum sizes per NEC or larger as indicated.
2. Quantities and sizes as per drawings.

3. Green insulation.

D. Bare Ground Wires:

1. For equipment bonding jumpers, equipment enclosures to the ground bus or lug, bonding conduit grounding fitting, and elsewhere as required.
2. # 6 AWG minimum for bonding jumpers.
3. Solid Conductors: Soft or annealed per ASTM B3, “Soft or Annealed Copper Wire.”
4. Stranded copper per ASTM B8, “Concentric Lay Stranded Copper Conductors.”

2.4 MISCELLANEOUS CONDUCTORS

A. Ground Bus: Bare annealed copper bars of rectangular cross section.

B. Braided Bonding Jumpers: Copper tape, braided No. 30 gauge bare copper wire, terminated with copper ferrules.

C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

2.5 GROUNDING ELECTRODE SYSTEM MAIN GROUND BUS BAR

A. Bus bar shall serve as the main grounding point for the grounding electrode system, and shall provide a visible connection point for all interconnected grounding and bonding conductors in main electrical room.

1. Bare annealed copper bars of rectangular cross section, 1/4" thick x 2" H x 18" L.
   a. Pre-drilled for single and double-hole, solderless lug connectors.
2. Insulated standoff mounting brackets with 1-1/2" insulators and 1" offset stainless steel bolts for rigid support.
3. Erico, or comparable product by Harger or Burndy.

2.6 TELECOMM MAIN GROUND BUS BAR (TMGB)

A. TMGB shall serves as the main grounding point for incoming telephone/data service(s) and/or building telecomm system:

1. UL467 Listed.
2. Tinned, plated annealed copper bars of rectangular cross section, dimensions as noted below.
3. Pre-drilled per BICSI with the following holes for bolted 1-hole solderless lug connections, as noted below.
1. 1/4" thick x 4" H x 20" L with 27 pair of 5/16” and 3 pair of 7/16” holes.
2. Insulated standoff mounting brackets with 1 1/2" insulators and 1" offset stainless steel bolts for rigid support.
3. Erico Eritech #TMGB-A**L**PT series, or comparable product by Harger or Burndy.

2.7 TELECOMM GROUNDING BUS BAR (TGB)

A. TGB shall serve as the grounding point within each telephone, data, fiber or patch room or closet, or other similar areas serving as IDF points.

1. UL467 Listed.
2. Tinned, plated annealed copper bars of rectangular cross section, dimensions as noted below.
3. Pre-drilled per BICSI with the following holes for bolted 1-hole, solderless lug connections, as noted below.
4. 1/4" thick x 2" H x 18" L with 10 pair of 5/16” and 3 pair of 7/16” holes.
5. Insulated standoff mounting brackets with 1 1/2" insulators and 1" offset stainless steel bolts for rigid support.
6. Erico Eritech #TGB-A**L**PT series, or comparable product by Harger or Burndy.

2.8 CONNECTOR PRODUCTS

A. General: Listed and labeled as grounding connectors for the materials used.

B. Pressure Connectors: High-conductivity-plated units.

C. Bolted Clamps: Heavy-duty units listed for the application.

D. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.

2.9 GROUNDING ELECTRODES

A. Ground Rods:

1. One piece, copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core.
2. Size: ¾ inch by 10 feet.

2.10 FLEXIBLE BONDING STRAPS

A. Flexible grounding/bonding straps for water meter jumpers, raised floor bonding, etc.

1. Flexible, tinned, pure copper braid.
2. Unplated, seamless pure copper rectangular ferrules at each end.
3. Burndy Type B, or equal.

PART 3 EXECUTION

3.1 APPLICATION

A. Equipment Grounding Conductor Application: Comply with NEC Article 250, “Grounding” for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.

1. Feeders and Branch Circuits: Install separate insulated equipment grounding conductors with circuit conductors. Terminate on panelboard or switchboard grounding bus bar, or on ground lug or bus in equipment enclosure, cabinet, etc. Splicing of equipment grounding conductors is not permitted.
2. Panelboards: All equipment grounding conductors shall terminate on a single ground busbar within the equipment enclosure. Bus bar shall be bonded to

enclosure.

3. Nonmetallic Raceways: Provide insulated equipment ground conductor in raceways with each branch circuit unless raceway is designated for telephone or data cables.
4. Air Duct Equipment Circuits: Provide insulated equipment grounding conductor to duct-mounted electrical devices operating at 120VAC and above, including humidifiers, air cleaners, heaters, etc. Bond the grounding conductor to each such unit and to the air duct.
5. Water Heaters: Provide separate insulated equipment ground conductor to each electric water heater. Bond grounding conductor to water heater and connected piping.

B. Underground Conductors: Bare, stranded copper except as otherwise indicated.

C. Telecommunications: Provide ground at all IT rooms, MDF, IDF and equipment frame locations per ANSI EIA/TIA-607, “Commercial Building Grounding and Bonding Requirements for Telecommunications” and as specified herein.

1. Provide grounding system which bonds all remote equipment rooms, racks, cabinets and/or frames to a ground bar in the main equipment room per ANSI.
2. Main telephone/data service room or MDF room:
   a. Provide TMGB with insulated, standoff brackets. Mount 18" AFF.
   b. Bond TMGB via #3/0 AWG stranded, insulated copper wire to the following:
   c. Building structural steel at nearest vertical column or beam via exothermic weld.
   d. Electrical system grounding electrode system directly to the main switchboard or panelboard ground bus, if accessible.
   e. Use hydraulic crimped lugs at TMGB and electrical ground bus connections.
   f. Each radial Telephone Bonding Backbone conductor shall connect directly to the TMGB.
3. All IDF and similar telephone/data room locations:
   a. Provide TGB with insulated, standoff brackets. Mount 18" AFF.
   b. Bond directly to the TMGB via #3/0 AWG TBB conductor, following the same route as the backbone or riser cables.
   c. Provide additional bond to nearest vertical steel column via exothermic weld.
4. Provide a Telephone Bonding Backbone (TBB) conductor to link closet or room TGB’s located remote from the TMGB. The TBB shall consist of the following:
   a. #3/0 AWG stranded, insulated copper wire installed along the same path as the telecomm riser or backbone cables.
   b. Bond directly to the TMGB.
   c. Bond to each TGB in closets or rooms through which the TBB passes.
5. All grounding and bonding conductors shall be stranded copper, with green insulation (or black with green identification at all connection points).
6. All connections to TMGB and TGB’s shall utilize hydraulic crimped copper lugs, with bolted connections to bus bars.
7. All connections to steel columns shall be made with exothermic weld process.
8. Split-bolt connectors are not permitted for any connections.
9. Bonding conductors shall be continuous between connection points. Do not splice bonding conductors.
10. Do not install in metallic conduit. Where physical protection is required, utilize PVC conduit (except in plenums).

D. Metal Lighting Poles: Ground pole to a local driven ground rod and bond to equipment grounding conductor run with supply branch circuit.

E. Lightning Protection System:

1. Bond grounding conductors and grounding conductor conduits to lightning protection down conductors or grounding conductors in compliance with NFPA 780, “Lightning Protection Code.”
2. Common Ground Bonding With Lightning Protection System: Bond electric power system ground directly to lightning protection system grounding conductor at closest point to electric service grounding electrode. Use bonding conductor sized same as system ground conductor and installed in conduit.

F. Building Structure & Grounding Electrode System Requirements:

1. Provide bonding jumpers to make all sections of building structural steel electrically continuous per NEC Article 250, “Grounding and Bonding.” Connections shall be mechanical or exothermic weld type.
2. Bond building steel to foundation rebar by welding rebar to column, or 500 MCM stranded copper wire with exothermic weld connection to rebar and columns.
3. Provide driven ground electrode (rods). Spacing of multiple rods shall be at least twice the length of each rod.
4. Provide connections to building water services (domestic and fire) via mechanical clamps.
5. Provide UFER Ground (Concrete-encased electrode) at building footing or foundation, as required by NEC Article 250, “Grounding and Bonding.”
    a. Fabricate with minimum of 20 LF of 500MCM bare copper conductor laid lengthwise in excavation for foundation or footings.
    b. Install conductor within 2 inches of the bottom of the concrete.
    c. Where base of foundation is less than 20 feet in length, coil excess conductor at base of foundation.
    d. Bond conductor to reinforcing steel at four locations, minimum.
    e. Extend conductor below grade and connect to building grounding grid or grounding electrode.

G. Dry Transformer Grounding:

1. Ground all transformer components per NEC.
    a. Secondary neutral.
    b. Primary and secondary grounding conductors.
    c. Enclosure.
    d. Bond all together and to building steel per NEC Article 250 “Grounding and Bonding”.
    e. Provide equipment ground conductor in primary feeder. Connect to transformer ground lug or bus.

3.2 INSTALLATION

A. General: Ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements.

B. Main Electrical Room and Substation Room Main Ground Busbar:

1. Size, location, and arrangement as specified, and as indicated on plans.
2. Space 2 inch from wall and support from wall 18 inches above finished floor, except as otherwise indicated.
3. Install using stainless steel mounting brackets and hardware, and non-conducting insulators.

C. Ground Rods:

1. Locate a minimum of two-rod lengths from each other and at least the same distance from any other grounding electrode.
2. Interconnect ground rods with bare conductors buried at least 24 inches below grade.
3. Connect bare-cable ground conductors to ground rods by means of exothermic welds except as otherwise indicated.
4. Make connections without damaging the copper coating or exposing the rod steel.
5. Drive rods until tops are 6 inches below finished floor or final grade except as otherwise indicated.

D. Metallic Water Service Pipe:

1. Provide insulated copper ground conductors, sized as indicated, in conduit from the building main service equipment, or the ground bus, to main metallic water service.
2. Connect ground conductors to the main metallic water service pipes by means of ground clamps.
3. Where a dielectric main water fitting is installed, connect the ground conductor to the street side of the fitting. Do not install a grounding jumper around dielectric fittings.
4. Bond the ground conductor conduit to the conductor at each end.

E. Water Meter Jumpers: Provide braided, flexible bonding straps to connect ground clamps on water meter piping to bypass water meters electrically.

F. Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.

3.3 CONNECTIONS

A. General: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.
2. Make connections with clean bare metal at points of contact.
3. Coat and seal connections involving dissimilar details with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.
4. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer’s published torque tightening values for connectors and bolts. Where manufacturer’s torque requirements are not indicated, tighten connections to comply with torque tightening values specified in

UL 486A, “Wire Connectors and Soldering Lugs for Use with Copper Conductors.”

B. Exothermic Welded Connections:

1. Use for connections to structural steel and for underground connections of conductors and rods.
2. Install at connections to ground rods and plate electrodes.
3. Comply with manufacturer’s written recommendations.
4. Re-make any welds that are puffed up or that show convex surfaces indicating improper cleaning.

C. Conductor Terminations:

1. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs.

D. Metallic Raceways:

1. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing.
2. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing.
3. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

E. Compression-Type Connections:

1. Use hydraulic compression tools.
2. Use tools and dies recommended by the manufacturer of the connectors.
3. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

F. Moisture Protection:

1. Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

3.4 PAD-MOUNTED EQUIPMENT GROUNDING

A. Padmounted Transformers and Generators:

1. Provide a minimum of two (2) driven rods, installed at opposite corners.
2. Interconnect with #4/0 AWG BCSD counterpoise at 24" depth.
3. Exothermic weld connections.
4. Provide ground conductor from one rods thru PVC conduit sleeve in bottom of pad to equipment ground bus connection.

3.5 REPAIR/RESTORATION

A. Restore all areas or surfaces disturbed by work of this contract, to pre-existing conditions.

1. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated.
2. Where sod has been removed, replace it as soon as possible after backfilling is completed.
3. Restore areas disturbed by trenching, storing of dirt, cable laying, and other Work to their original condition.
4. Include necessary topsoil, fertilizing, liming, seeding, sodding, sprigging, or mulching.

3.6 FIELD QUALITY CONTROL

A. General:

1. Before making tests, complete all connections at panels, fixtures and other equipment.
2. Install fuses and have all wiring continuous from service equipment to utilization outlets.
3. Correct all undesirable ground, open and short circuit conditions.
4. Arrange and pay for the services of a qualified independent electrical testing organization to perform tests described below.

B. Acceptance Testing: Take and record the following readings on applicable systems, as described below:

1. Site Tests:
   a. Provide tests of the completed grounding system using a megohmeter at each location where a maximum ground resistance level is specified.
   b. Measure ground resistance at least 48 hours after any precipitation and without the soil being moistened by any other natural or artificial means.
   c. Tests shall be performed without chemical treatment or other artificial means of reducing natural ground resistance.
   d. Perform test by the Fall of Potential (3-point) method in accordance with IEEE 81 Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System.
2. Ground resistance maximum values shall be as follows:
   a. Building Grounding electrode driven rods:
   b. Rated 500 kVA and less: 10 Ohms
   c. Rated >500 kVA: 5 Ohms
   d. Lightning protection system ground: 5 Ohms
   e. Lighting pole grounds: 15 Ohms
   f. Emergency generator local ground: 10 Ohms
3. Feeder Equipment Grounding Conductor Tests:
   a. Perform test by the 2-point method to verify impedance in the ground system between installed components, including, but not limited to the following:
      1) Service Disconnect Switches panelboard or transformer and main grounding busbar.
      2) Branch panelboards to feeder source.
      3) Dry transformers to primary feeder source.
      4) Grounding equipment riser(s) (for transformers) from farthest point to point of connection at building main grounding busbar, switchboard ground, or other source connection point.

4. Neutral-Ground Bond Testing:
   a. Test distribution system for presence of neutral-to-ground bonds at points other than service entrance and/or separately derived sources.
   b. Remove permitted N-G bond at point of common coupling, and verify no continuity between neutral and ground systems.
   c. Record the measured isolation (megohms) between the neutral and ground systems.
   d. Where continuity is found, provide further investigation to locate and remove such bonds.

3.7 ADJUSTING

A. General:

1. Make and perform all adjustments after all building grounding systems are complete.

B. Deficiencies of Service or Building Ground Systems:

1. Where ground resistance exceeds specified values, notify the Architect immediately.
2. Modify the grounding system to reduce resistance values.
3. Provide additional ground rods, interconnected with the others, installed at least 10 feet between rods.
4. Retest ground resistance after modifications.
5. Where values still exceed those specified, the Architect will provide additional direction.

C. Unintentional Bonding of Grounds, Neutrals, etc. of Service or Building Ground Systems:

1. Perform additional testing and measurements to locate the unintentional bonds.
2. Remove unintentional bonds.
3. Retest system(s) to prove desired isolation of systems.

D. Reports:

1. Prepare test reports, certified by the testing organization, of the ground resistance at each test location.
2. Include observations of weather and other phenomena that may affect test results.
3. Indicate measures taken to improve test results.
4. Provide all final measurements of system isolation tests (megohms).

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Section Includes:

1. Conduits.
2. Conduit fittings and supports.
3. Wireways.
4. Multi-outlet assemblies.
5. Device and outlet boxes.
6. A/V Wall Connection boxes.
7. Pull and splice boxes.
8. Floor mounted devices.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Section “Common Work Results for Electrical.”
2. Section “Grounding & Bonding for Electrical Systems” for coordination with grounding equipment and attachments.
3. Section “Low Voltage Electrical Power Conductors and Cables” for conductors to be installed in raceways.

1.3 SUBMITTALS

A. Submittal Requirements of this section:

1. Conduits.
2. Multi-outlet assemblies.
3. A/V wall connection boxes.
4. Floor mounted devices.

B. Descriptive Data:

1. To verify specifications have been met/exceeded.
2. Indicate UL listing for all products.
3. Manufacturer's specifications, data sheets.
4. Catalog cuts.
5. Dimensional drawings.
6. Capacity ratings.
7. Information required indicating contract compliance.
8. Clearly indicate the exact size or rating proposed.

C. Closeout Submittals: Submit in accordance with the General Conditions and Division 01

requirements.

1.4 DELIVERY, STORAGE AND PROTECTION OF EQUIPMENT

A. Packing, Shipping, Handling and Unloading:

1. Transport and handle all equipment to prevent bending, distortion or damage to products.

B. Storage and Protection:

1. Store all materials out of rain.
2. Protect from physical damage.
3. Guard against nicks and scratches on finished surfaces.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, provide the named “Basis of Design” manufacturer and model (“Basis of Design” fixtures are indicated on the drawing fixture schedule), or a comparable product of one of the other following named manufacturers:

1. Steel Conduits & Fittings:
   a. Allied Tube & Conduit
   b. American Electric/Steel City
2. Non-Metallic Conduits & Fittings:
   a. Carlon
   b. Cantex
3. Surface raceways & Multi-outlet assemblies:
   a. Wiremold
   b. MonoSystems, Inc.
   c. Hubbell
4. Floor mounted devices:
   a. Wiremold
   b. Hubbell
   c. MonoSystems, Inc.

2.2 METAL CONDUIT AND TUBING

A. Rigid Galvanized Steel Conduit (RGS):

1. ANSI C80.1 Rigid Steel Conduit, Hot dip Galvanized
2. UL 6 Electrical Rigid Metal Conduit - Steel.
3. Meets NEC Article 344, “Rigid Metal Conduit.”
4. Material: Steel heavy-wall, hot dip galvanized inside and outside.
5. Joints: Standard pipe thread; furnished with coupling; shipped with thread protector through 2-inch size.
6. Minimum Size: 3/4 inch.

B. Intermediate Metal Conduit (IMC):

1. ANSI C80.6 Intermediate Metal Conduit - Zinc Coated.

2. UL 1242 Intermediate Metal Conduit.
3. Meets NEC Article 342 Intermediate Metal Conduit.
4. Material: Steel only, intermediate wall thickness, hot dipped galvanized.
5. Joints: Standard Pipe Thread, furnished with coupling, shipped with thread protector through 2-inch size.
6. Minimum Size: 3/4 inch.

C. Electrical Metallic Tubing (EMT):

1. ANSI C80.3 Electrical Metallic Tubing - Zinc Coated.
2. UL 6 Rigid Metal Conduit.
3. Meets NEC Article 358, “Electrical Metallic Tubing.”
4. Material: Steel, thin-wall, electro-galvanized.
5. Minimum Size: 3/4 inch.

D. Flexible Metal Conduit (Greenfield):

1. UL 1 Flexible Metal Conduit.
2. Meets NEC Article 348, “Flexible Metal Conduit.”
3. Material: Electro-galvanized, or zinc-coated steel.
4. Minimum Size: 3/4 inch.

E. Liquid tight Flexible Metal Conduit (Sealtite):

1. UL 360 Liquidtight Flexible Steel Conduit.
2. Meets NEC Article 350, “Liquidtight Flexible Metal Conduit and Liquidtight Flexible Nonmetallic Conduit.”
3. Flexible steel conduit with PVC jacket.
4. Galvanized flexible steel core.
5. Extruded PVC jacket, gray or black.
6. Minimum Size: 3/4 inch.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Rigid Nonmetallic Conduit (RNC):

1. Schedule 40 or 80 PVC.
2. Meeting NEMA publication TC-2, “Electrical Plastic Tubing” (EPT) and “Conduit” (EPC-4 and EPC-80).
3. UL-651 Schedule 40 and 80, “Rigid PVC Conduit.”
4. Material complies with ASTM D 1784, “Standards for PVC compounds and CPVC compounds.”
5. Meets NEC Article 352, “Rigid PVC Conduit.”

2.4 CONDUIT FITTINGS

A. All fittings to match conduit material and to be suitable for the purpose intended. All fittings shall be UL Listed.

B. Hazardous Location seal off fittings:

1. Compound filled, malleable iron.
2. Class & Division as required
3. 40% fill capacity.

4. Listed under UL 886, “Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations”, vertical or horizontal application, as required.
5. Crouse Hinds, OZ Gedney, Killark.

C. Expansion Fittings:

1. Weather tight construction.
2. Copper braid bonding strap & clamps.
3. Crouse Hinds, or equal.

D. RGS/IMC Fittings:

1. Threaded with insulated bushings.
2. Galvanized steel or malleable iron.
3. Double locknuts.
4. Crouse Hinds, Steel City, Bridgeport, or equal.

E. EMT Fittings:

1. Compression type "Concretight" or "Raintight.”
2. Zinc plated steel body and steel nut.
3. Insulated throats.
4. Setscrew fittings not permitted.

F. Sealtite Conduit Fittings:

1. Threaded ferrule, malleable iron compression nut and body.
2. Nylon sealing ring.
3. NEMA FB-1, “Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.”

G. Flexible Metal Conduit/MC Cable Fittings:

1. 360^{o} squeeze type.
2. Malleable iron or cast zinc bodies.
3. Insulated throat.
4. Anti-short bushings

H. PVC Conduit Fittings:

1. Formed PVC, sunlight and UV resistant, UL Listed.
2. Schedule 40 or 80 to match conduit or tubing type and material.
3. Material complies with ASTM D 1784, “Standards for PVC compounds and CPVC compounds.”
4. Meets NEC Article 347, “Rigid Nonmetallic Conduit.”
5. Meeting NEMA publications TC-3, “PVC Fittings for use with Rigid PVC Conduit and Tubing.”
6. Fittings Listed under UL-514B, “Fittings for Cable and Conduit.”
7. Medium voltage underground or sub-slab conduit systems:
   a. Minimum 36” bend radius for all conduit turn-ups into gear or pads.
   b. 25 ft radius, long-sweep bends for all bends and offsets in underground or sub-slab runs.
   c. End bells with smooth, flared ends for all conduits terminating under pad-mounted switchgear, switchboards, transformers, etc.

8. Conduit and elbows with factory belled end.
9. Carlon Plus 40 conduit and fittings, or equal.

2.5 CONDUIT SUPPORTS

A. Single suspended feeder conduit:

1. 1/2" - 2" Conduit: Adjustable hangers with 3/8" rods.
2. > 2" Conduit: Adjustable hangers with 1/2" rods.
3. Kindorf C-149 or C-150, B-line, or equal.

B. Groups of suspended conduits:

1. Steel channels with conduit straps.
2. 1/2" threaded rods, minimum.
3. Kindorf, B-Line, or equal.

C. Flexible metal conduit, MC Cable:

1. UL Listed Caddy Clips, or similar attachment methods.

D. Surface mounted conduit:

1. 1 or 2-hole pipe straps.

2.6 WIREWAYS

A. Material: Sheet metal sized and shaped as indicated.

B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireway as required for complete system.

C. Wireway Covers: Hinged type, secured with stainless steel screws.

D. Finish: Manufacturer's standard enamel finish, ANSI 49 or 61 gray.

E. NEMA Rating:

1. NEMA 1 for dry, indoor locations.
2. NEMA 3R for outdoor or areas exposed to weather or severe moisture.

2.7 SURFACE RACEWAYS & MULTI-OUTLET ASSEMBLIES

A. General Construction

1. Steel construction, ivory, scratch resistant finish.
2. Two-piece, separable base and coverplate.
3. Complete with entrance junction boxes, wire retainer clips, device brackets, end plates, etc.

B. Divided, 2-compartment metal raceway.

1. Separate power and low voltage compartments.

2. Power outlets of NEMA type and locations per drawings.
3. Duplex RJ-45, snap-in data/voice jacks in LV compartment, where indicated, as specified in Section "Structured Cabling."
4. Metallic device coverplates. Ends cut flush and tight to adjacent raceway cover ends.
5. With manufacturer's precut corners, endplates, and fittings.
6. Wiremold V4000 Series (white finish).

2.8 DEVICE & OUTLET BOXES

A. Indoor boxes - zinc-coated or cadmium plated steel, NEMA OS-1.

B. Wiring device boxes for surface mounting in unfinished spaces:

1. Full-size (4" high) boxes required for all wiring devices (switches, outlets, etc.). 3"x2" switch boxes, handy boxes or other reduced-size boxes are not permitted. One-piece, zinc-coated drawn steel, NEMA OS-1.
2. Square boxes with rounded corners and no sharp, protruding edges.
3. Knockouts on all four sides.
4. Pre-drilled mounting holes, and ground wire screw holes.
5. Raised device coverplates for switches or outlets, as required. T&B RS Series.
6. Thomas & Betts, or equal.

C. Unheated, "damp" and "wet" locations and outdoor locations:

1. NEMA 4 cast-aluminum, cast steel or cast iron.
2. Threaded hubs for surface mounted boxes.
3. "White metal" boxes rated NEMA 4 are not acceptable.
4. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

D. Outlet boxes in un-plastered brick or block walls shall be provided with deep square-cut device covers.

E. Surface boxes in prisoner-accessible locations:

1. NEMA 4 cast steel or cast iron.
2. No exposed or accessible knockouts or unused threaded hubs.
3. Threaded hubs for surface mounted boxes. Single or multi-hubs as required.
4. "White metal" boxes rated NEMA 4 are not acceptable.
5. Stainless steel tamper-proof hardware as specified elsewhere.
6. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

F. All boxes sized to meet the requirements of the NEC.

G. Provide "stud-to-stud" or "dual box to stud" mounting brackets to insure all adjacent boxes are level. Thomas & Betts, or equal

H. Furnish all boxes with appropriate covers.

I. No sectionalized boxes shall be used.

2.9 JUNCTION AND PULL BOXES

A. Dry locations:

1. 12 gauge galvanized sheet steel minimum.
2. Flat covers secured in position by round head brass or stainless steel 300 grade machine screws.
3. NEMA OS-1, “Sheet Steel Outlet Boxes, Covers and Box Supports.”

B. Exterior and wet locations:

1. Cast aluminum or galvanized cast-iron type.
2. Threaded hubs.
3. Gasketed screw-on cover plates.
4. NEMA FB-1, “Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.”

C. Boxes imbedded in concrete:

1. NEMA 4X PVC.
   a. Glue-in conduit hubs.
   b. Gasketed coverplates.
   c. Sunlight (UV) resistant.

D. Surface boxes in prisoner-accessible locations:

1. NEMA 4 cast steel or cast iron.
2. No exposed or accessible knockouts or unused threaded hubs.
3. Threaded hubs for surface mounted boxes. Single or multi-hubs as required.
4. "White metal" boxes rated NEMA 4 are not acceptable.
5. Stainless steel tamper-proof hardware as specified elsewhere.
6. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

E. All boxes sized to meet the requirements of the NEC.

2.10 RECESSED A/V WALL BOXES

A. Provide recessed wall boxes for concealed power and low voltage cabling connections to wall mounted flat panel TV’s, flat screens, etc., where indicated.

1. Recessed main body, designed to fit within 2x4 stud wall construction.
2. Top and bottom concentric conduit knockouts for (1) ¾” to 1-1/4” and (1) 1-1/4” to 2”.
3. Feed-thru side tunnels for passing power or LV cabling thru housing.
4. Removable dividers for separating power and low voltage devices/cabling.
5. Removable interior device module designed to accept two (2) standard 2x4 wiring devices and coverplates.
6. Wiring device locations shall accept power, A/V, data or other connectors using standard 2x4 box mounting. No proprietary wiring devices or mountings.
7. Front paintable trim ring, and decorative cover to conceal devices/plugs, with room to pass cables out to flat panel.
8. U.L. Listed.

9. Wiring devices, as specified elsewhere.
10. Wiremold Evolution Series (#EFSB2) wall boxes, or comparable product.

2.11 FLOOR MOUNTED DEVICES (POKE-THRU TYPE)

A. Poke Through Floor Outlets – 4” Diameter, 2-gang devices.:

1. Mounted in 4" core drilled hole in slab.
2. Recessed device mounting below hinged cover.
3. Capacity for 2-gangs of devices.
4. Fitted with duplex 20 amp power receptacles, flush service head.
5. Low voltage ports with Cat 5E RJ45 jacks, per IT design drawings.
6. Integral fire and smoke barrier – 2-hour rated.
7. Separate low voltage and power raceways.
8. Flush hinged metal cover. Operable without tools.
9. Slide plates to allow cable passage with cover closed.
10. Satin nickel, satin brass or brushed aluminum finish to be selected by architect.
11. ADA compliant.
12. LeGrande Wiremold Evolution 4” Series Poke-Thru, or approved equal.

2.12 FLUSH MULTI-SERVICE FLOOR BOXES

A. Complete in-floor multi-service box consisting of floor box housing, flush removable cover, and wiring devices, as specified, all fittings, materials and labor.

1. Adjustable leveling and placement during rough in to accommodate structural and architectural elements, and other equipment.

B. Construction:

1. Galvanized steel per ASTM 525 G-60.
2. Concrete-tight for in-floor use.
3. Hinged access lid with grommeted cable ports to allow lid closure with receptacles in use.
4. UL scrubwater compliant.
5. ADA compliant.
6. Adjustable legs for leveling and adjustment prior to pour.
7. Knockouts for conduit entry and feed through use.
8. 4 compartment box, individually sectionalized.
9. 2 - Duplex 5-20R power receptacles.
10. 2 - Duplex data RJ45 jacks, Category 5E.
11. UL Listed, with separation of power and low voltage.
12. Completely flush, rectangular, brass cover with hinged access lids. Floor covering trim, as required.

C. Wiremold RFB4 Multi-service steel recessed floor boxes or MonoSystems Concrete Floor Boxes, or comparable product.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of the raceway

system. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine areas to receive cable trays. Make adjustments to elevations, routing, etc. to coordinate with other work including beams, lights, ducts, pipes, etc.

3.2 APPLICATION

A. General Exterior Conduit Applications:

1.	Direct buried:	PVC, RGS
2.	Concrete ductbank:	PVC
3.	Above grade, building surfaces:	IMC, RGS
4.	Roof surfaces:	IMC
5.	Below covered roofs/overhangs:	IMC, EMT
6.	Motors, pumps, etc.	Sealtite

B. General Interior Conduit Applications:

1.	All panelboard or ATS feeders:	
	a. Above slab:	EMT
	b. Below floor slab:	RGS, PVC*
	1) *RGS required where conduit penetrates through slab.	
2.	HVAC equipment circuits:	
	a. (>30 amps):	EMT
	b. (≤ 30 amps):	EMT, MC Cable
	c. Below floor slab:	RGS, PVC*
	1) *RGS required where conduit penetrates through slab.	
3.	Branch circuits (lighting, receptacles):	
	a. Above accessible ceilings:	EMT, MC Cable
	b. Above inaccessible ceilings:	EMT, MC Cable
	c. Concealed in CMU walls:	EMT, PVC
	d. Within solid masonry walls:	EMT, PVC
	e. Concealed within stud walls:	EMT, MC Cable
	f. In or below slab on grade to flush floor boxes:	PVC
4.	Final Connections to Lights, dry transformers, small motors, vibrating equipment:	
	a. Indoor, dry locations:	Greenfield
	b. Outdoor, damp locations:	Sealtite
5.	All prisoner accessible areas:	
	a. Above accessible ceilings:	EMT, MC Cable
	b. Above inaccessible ceilings:	EMT, MC Cable
	c. Surface mounted:	IMC, RGS

3.3 INSTALLATION

A. General:

1. Coordinate layout and installation of all raceways, cable trays, boxes and other equipment with other construction elements to ensure adequate headroom, working clearance, and access and to eliminate interference problems.
2. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
3. Do not cut or drill structural members without permission of Architect. Provide reinforcing for opening as directed by Architect.

4. Pierce metal deck where required for installation of electrical equipment.
5. Support raceways and equipment as required by NEC, manufacturers, and as specified elsewhere.
6. Provide grounding connections for raceway, boxes, and components as indicated and instructed by manufacturer.
7. Tighten connectors and terminals, including screws and bolts, per manufacturer's published torque values, or per UL 486A, “Standard For Wire Connectors and Soldering Lugs for Use With Copper Conductors” where not specified.

B. Tamper Proof Hardware

1. Provide tamper proof hardware for all panels, pullboxes, junction boxes, coverplates, and any other equipment or items accessible to prisoners, as indicated on the drawings.

3.4 CONSTRUCTION

A. Flexible Connections: Use maximum of 6 feet of flexible conduit for connections to equipment subject to vibration, noise transmission, or movement, and for all motors. Use liquid tight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections. Provide flexible connections as follows:

1. Connections to motors between rigid conduit and connection box on motor.
2. Connections to equipment containing motors (power and control conduits).
3. Connections to generators (ALL power, control and monitoring conduits).
4. Connections to equipment subject to movement, rotation, vibration or oscillation.
5. Connections from rigid conduit system to recessed lights.
6. Connections to dry-type transformers.
7. Other applications, as indicated.

B. Supports: Provide all supports, hangers, braces and attachments required for the work of this section.

3.5 CONDUIT INSTALLATION

A. General Installation Requirements:

1. Install all conduit concealed, unless not possible.
2. Surface mounting only as approved by Architect.
3. Minimum size 3/4” inch, unless noted otherwise.
4. Minimum 6" clearance from flues, heating pipes, or other hot surfaces above 80^{o}F.
5. Parallel and perpendicular to walls, structural members, ceilings and interior surfaces; install plumb.
6. Polypropylene or nylon pull line in each empty conduit.
7. Use capped bushings or plugs during construction.
8. Clean and cap all conduits left empty for future use.
9. In masonry, install prior to wall construction and accurately set all outlets.
10. Where conduit passes through exterior walls, floor or roof, install appropriate fittings and materials to make openings watertight. Repair pierced vapor barriers vapor-proof. Provide flashing for each conduit piercing the roof.

B. Exposed Conduit in Exposed Ceiling Areas:

1. Install all conduit tight to underside of deck, above all ducts, piping, etc.
2. Install conduits within joist webbing and through spaces between steel beams and structure, as high as possible.
3. Install parallel with building walls, beams and main structural elements.
4. Minimize offsets by coordinating with other trades prior to installation.
5. Install pull and junction boxes where least visible. Install on far side of ducts, etc., as visible from the majority of room viewpoints.

C. Raceways Embedded in Slabs: Install in slabs only where explicitly shown on drawings. Install in middle third of the slab thickness where practical, and leave at least 1” inch concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.
3. Run conduit larger than 1” inch trade size parallel to or at right angles to main reinforcement. When at right angles to reinforcement, place conduit close to slab support.
4. Transition rigid nonmetallic conduit to rigid galvanized steel (RGS) conduit before rising above floor slab.
5. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
6. Stub-Up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6” inches above the floor. Where equipment connections are not made under this Contract, install screwdriver-operated threaded flush plugs flush with floor.

D. Flexible Conduit Installation Requirements:

1. Group all flexible conduits running together in bundles with nylon cable ties.
2. Route bundles neatly through ceiling cavities.
3. Avoid constant changes in direction and elevation of bundles.
4. Install perpendicular and parallel to column lines, except for final separation from bundles.
5. Support bundles at regular intervals, per NEC, independent from ceiling hanger wires.
6. Provide adequate clearance above accessible ceiling tiles, minimum of 18.”
7. Where flexible conduit or MC cable is used for final connections to motors, lights, etc., maximum length shall be 6 feet.

E. Installation in Prisoner Cellsand All Areas Accessible to Prisionerss.

1. Surface Installations:

   a. All conduit connections shall be threaded for connections of IMC or RGS conduits.
   b. Conduits shall be strapped to wall with 2-hole straps within 2 ft of each termination into box, etc.
   c. Conduit runs shall be attached to masonry surfaces every 8-10 LF with 2-hole pipe straps.

F. Fittings & Terminations:

1. Provide expansion fittings in all conduit where crossing building expansion joints.
2. Provide expansion fittings in all runs of PVC conduit, a minimum of 1 between every 2 fixed points.
3. Tighten compression fittings within wrenches.
4. Terminations: Use two locknuts, one inside and one outside the box. Provide insulated bushings or throats.
5. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
6. Sealing Fittings: Install per manufacturer's instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. Install raceway sealing fittings on conduit at the following points and elsewhere as indicated:
   a. Entering/leaving hazardous locations.
   b. Where otherwise required by the NEC.

3.6 WIREWAY INSTALLATION

A. Install per NEC Article 362. Provide hinged connectors to join adjacent lengths. Connect all sections solidly to insure effective grounding of wireway system.

B. Mount wireway in accessible location, with hinged section facing in proper direction.

C. Use standard manufactured lengths to fit in available space. Do not cut standard lengths in field. Provide cut-off fitting where non-standard length is required, and cut in field as required.

D. Clear all obstructions encountered in field. Provide offsets and appropriate fittings as required to clear obstructions.

E. Provide closing plate at ends of wireway. Install wire retainers in wireway after conductors are in place. Provide adapter where wireway is connected to box and cabinet.

F. Use 12" section of wireway to pass through wall, to allow maximum accessible length on each side. Provide special escutcheon plate on each side of wall to finish opening neatly.

3.7 SURFACE RACEWAY & MULTI-OUTLET ASSEMBLY INSTALLATION

A. General:

1. Install level and plumb.
2. Install tight to mounting surface.
3. Cut ends of all raceways perpendicular. Leave no sharp edges or burrs.
4. Provide separate low voltage and power feeds to all multichannel raceways.
5. Securely mount wiring devices into raceways.
6. Provide manufacturer’s wire retaining clips to secure wires.
7. Provide manufacturers fittings for all corners, box entries, etc.

3.8 DEVICE & OUTLET BOX INSTALLATION

A. General Requirements:

1. Install all boxes plumb and level.
2. Install boxes at heights required. Refer to Section “Wiring Devices.”
3. Install recessed boxes flush with final finished surface.
4. Secure all boxes such that no movement occurs during normal use.
5. Install ceiling mounted boxes with sufficient support and rigidity to prevent movement during normal connecting and disconnecting procedures.
6. Install power and low voltage device boxes at same heights from floor or counters.
7. Consistent Mounting Heights: Provide installation of boxes at the same and consistent mounting heights throughout project. Where multiple switch boxes or power and low voltage boxes are installed in close proximity, use “stud-to-stud” or “dual box to stud” mounting brackets to insure all boxes are level.

B. Installation in Prisioner Cellsooms and All Areas Accessible toPrisoners.

1. Recessed Installations:
   a. Where installed in concrete, CMU or other masonry wall construction, box openings shall be carefully cut to size with no noticeable play or gaps.
   b. Fill all voids behind and around boxes so that masonry prevents any and all movement in the box and attaching conduits.
   c. Boxes shall be precisely set to the exact depth so that NO gaps exist between coverplate and wall surface, or between coverplate and box.
   d. All box covers, coverplates or devices shall be attached via stainless steel tamper-proof screws as specified elsewhere.

2. Surface Mount Installations:

   a. Install backboxes, junction boxes and other device mounting boxes with minimum of two (2) concrete anchors per box.
   b. All conduit to box connections shall be threaded for connections of IMC or RGS conduits.
   c. Boxes shall be installed tight to surface with no voids behind box.
   d. Conduits shall be strapped to wall with 2-hole straps within 2 ft of each termination into box, etc.
   e. All box covers, coverplates or devices shall be attached via stainless steel tamper-proof screws as specified elsewhere.

3.9 RECESSED A/V WALL BOX INSTALLATION

A. A/V Wall Boxes:

1. Install boxes plumb and level.
2. Coordinate installed boxes heights with proposed flat panel TV’s, etc. such that wall box is fully concealed by flat panel.
3. and.
4. Coordinate recessed box location and concealed conduit with flat panel mounting brackets and support blocking to avoid interference with flat panel mounting bracket(s)
5. Install recessed boxes flush with final finished surface.
6. Install power (3/4”) and low voltage (2”) conduits from ceiling cavity and or floor, per drawings.
7. Install power and low voltage wiring devices in wall box. Refer to Section “Wiring

Devices."

3.10 FLOOR MOUNTED DEVICE BOX INSTALLATION

A. Floor Mounted Devices - General:

1. Set floor boxes level and adjust to floor surface.
2. Make adjustments in fittings, lengths and placement during rough in to accommodate structural and architectural elements, and other equipment.
3. Coordinate exact locations and orientation with Owner prior to concrete pour.

B. Poke Through Floor Outlets:

1. Provide core-drilled hole in slab, size per outlet manufacturer.
2. Mount device flush in slab.

C. Flush In-Floor Device Boxes:

1. Set boxes prior to concrete pour.
2. Coordinate exact positions with Architect, Owner and related equipment.
3. Provide separate conduit connections for power and low voltage sections.
4. Protect housing with cover during concrete pour.
5. Adjust for final height and make level after pour.
6. Set trim rings and covers, adjust for flush fit with final floor covering or finish.

3.11 REPAIR/RESTORATION

A. Restore all finishes, equipment and surfaces to original condition, where affected by the work of this section.

3.12 CLEANING

A. General:

1. Remove paint splatters and other spots, dirt, and debris.
2. Touch up scratches and marred finishes to match original finishes.
3. Clean front of all coverplates, etc. using methods and materials recommended by manufacturer.

END OF SECTION

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Section Includes:

1. Utility coordination.
2. Marker tape.
3. Underground ductbanks.
4. Direct Buried conduit.
5. Handholes.

B. Related Sections:

1. Section “Common Work Results for Electrical” for concrete padsand other related equipment.
2. Section “Grounding and Bonding For Electrical Systems” for ground rods, grounding and bonding requirements of utility structure components.
3. Section “Low Voltage Power Conductors and Cables” for grounding conductors and attachments
4. Section “Raceways and Boxes For Electrical Systems” for conduit specifications.
5. Section “Packaged Generator Assemblies” for generators and related equipment installed in/or the ground.

1.3 SUBMITTALS

A. Submittal Requirements of this section:

1. Utility Marker Tape
2. Ductbank spacers
3. Handholes, covers & accessories

B. Product data, including construction, materials, ratings, etc.

C. Submit the following for each handhole:

1. Manufacturer/cat. number.
2. Manufacturer’s dimensional drawing(s).
3. Indicate open or closed bottom.
4. Type, rating, color and labels of covers.
5. Type and material of lid hardware.
6. Additional information to show compliance with specifications or drawings.

D. Product Test Reports: Certified copies of handhole or manhole manufacturer's design,

factory tests, required by the referenced standards.

1.4 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms “Listed and Labeled”: As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.

B. Manufacturer/Vendor Requirements:

1. Coordinate the components of the system and their arrangements electrically and mechanically.

C. Installation Quality: In accordance with recognized trade organizations and standards.

1. ANSI (American National Standards Institute)
2. NEC (National Electrical Code)
3. NECA “Standards of Installation”
4. NEMA (National Electrical Manufacturers Association)

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Provide all transportation of equipment to site.
2. Provide for rigging needed for unloading, and setting large manholes or handholes into final position.

B. Storage and Protection:

1. Protect all utility structures from damage prior to installation.

1.6 SEQUENCING

A. General Sequencing:

1. Coordinate with other underground utilities and structures such that deeper equipment is installed first, where possible.
2. Provide stakeout of all underground and in-ground equipment to identify conflicts prior to trenching or excavation.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Composite Handholes:

a. Hubbell Power Systems, Inc. Quazite
b. Mansfield Oldcastle Precast, Inc.
c. Fiberlyte

2.2 BURIED UTILITY MARKER TAPE

A. Non-biodegradable 3" wide plastic marker tape 12" below grade above every ductbank and buried conduit or cable. A system description (i.e. "ELECTRIC") shall appear continuously along its length. Tape shall meet ASTM D1712, “Standard Practice for Resistance of Plastics to Sulfide Staining” tests for color fastness. Tape shall contain a metallic core, which can be detected after burial in ground. Color coding per ANSI Z535.1.

1. Electric Red

2.3 UNDERGROUND DUCTBANKS

A. General:

1. Underground ductbanks shall be arrangements of single bore, PVC plastic conduits, concrete encased with (where indicated) steel rebar.

B. Materials:

1. Conduit and Fittings:
   a. UL Listed, Type II, heavy-wall schedule 40 PVC.
   b. Conduit and fittings shall be as specified in Section ”Raceways and Boxes For Electrical Systems.”
2. Concrete:
   a. 3,000 psi test at 28 days.
   b. Pea gravel aggregate for void-free duct penetration.
3. Reinforcing:
   a. Deformed conforming to ASTM A615, “Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement,” Grade 40 or Grade 60, minimum ½.”
   b. Coated rebar where exposed to earth, such as on ductbank stubouts.
4. Spacers:
   a. Precast plastic, base and intermediate.
5. Joint Sealant:
   a. Watertight as per by conduit manufacturer.
6. Cable Sealing Bushings:
   a. OZ type CSB, with PVC coated discs, or equal.
7. Thruwall and Floor Seals:
   a. OZ type "FSK" or "WSK", or equal.

2.4 DIRECT BURIED CONDUIT

A. For direct buried 600 volt electrical circuits:

1. PVC schedule 40 or PVC coated galvanized steel conduit, as indicated.
2. Conduit as specified in Section “Raceways & Boxes For Electrical Systems.”
3. Schedule 40 PVC expansion fittings, suitable for exterior applications, and sunlight resistant. Lubricated seals. UL Listed. Male or coupling ends as required. Carlon, or approved equal.

2.5 IN-GROUND HANDHOLES

A. Construction:

1. Minimum size 18"x18"x24"D, unless noted otherwise.
2. Lightweight composite construction.
3. Sand/aggregate mixture bound with polymer and reinforced with woven glass strands.
4. Compressive strength 11,000 psi.
5. Flexural strength 7,500 psi.
6. Structural capacity of handhole and lid meeting AASHTO Tier 15 for loading (15,000 pound design load)
7. Heavy duty textured covers, tan or gray color.
8. All components sunlight resistant.
9. Threaded inserts and stainless steel bolts for covers.
10. Logo shall be integral with cover to indicate "ELECTRIC", “SITE LIGHTING”, etc.
11. Open bottom.
12. Hubbell Power Systems, Inc. Quazite Composolite, or comparable product by Fiberlyte.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions:

1. Examine the site where the work is proposed.
2. Make allowances where proposed work shall cross, intersect or otherwise be affected by existing conditions.

3.2 PREPARATION

A. Utility Coordination:

1. Contact MISS UTILITY, national “811” and/or (1-800-257-7777) prior to any excavation or underground work. Arrange for marking of all utilities.
2. Contact serving utility companies immediately upon award of contract. Do not install related equipment until fully coordinated with appropriate utilities.
3. Provide all construction schedules, dates of requested services, outage windows, equipment locations, etc. necessary for utility work.
4. Electric Utility:
   a. Coordinate underground service entrance equipment and layout with Power Company prior to ordering or installing any service related equipment.

3.3 ENCASED & DIRECT BURIED CONDUIT INSTALLATION

A. General Requirements:

1. Install nonmetallic conduit and duct as indicated according to manufacturer’s written instructions.
2. Determine exact plans and profiles of underground conduit and ducts, based on field information and available as-built plans.
3. Perform test pits at all utility crossings as shown on plans and available as-built

drawings. Locate all shown utilities and structures, and make adjustments to proposed work.

4. Verify location and inverts of existing utilities at proposed points of connection.
5. Slope: Pitch ducts minimum of 4 inches per 100 feet (1:300) to drain toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between manholes or handholes to drain in both directions.
6. Make all conduit joints and fittings watertight per to manufacturer's instructions.
7. Stagger couplings so those of adjacent ducts do not lie in the same plane.

B. Curves and Bends: Use manufactured elbows with a minimum radius of 36" for stub-ups only at equipment and at building entrances. Use manufactured long sweep bends with a minimum radius of 25 feet both horizontally and vertically at other locations and for all telecomm applications.

C. Duct Entrances to Handholes: Provide horizontal penetration of conduit into handholes. Utilize manufacturer's knockouts or field cut a punched hole opening for conduit. Gradually transition conduit from specified buried depth to knockout locations.

D. Separation Between Direct-Buried, Non-encased Ducts: 3 inches minimum for like services, and 6 inches minimum between power and signal ducts.

E. Concrete-Encased Nonmetallic Ducts:

1. Support on plastic separators coordinated with duct size and required duct spacing.
2. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, and secure separators to the earth and to ducts to prevent floating during concreting. Do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
3. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not use power-driven agitating equipment unless specifically designed for duct bank application. Pour each run of envelope between manholes or other terminations in 1 continuous operation. When more than one pour is necessary, terminate each pour in a vertical plane and install: 1-inch reinforcing rod dowels extending 18 inches into the concrete on both sides of joint near the corners of the envelope.
4. Reinforcing: Reinforce duct banks where they cross disturbed earth and where indicated.
5. Forms: Use the walls of the trench to form the sidewalls of the duct bank where the soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Clearances Between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts. Concrete envelope - 4 inches beyond surface of any conduit or duct.

F. Stub-Ups: Use Schedule 40 PVC conduit for stub-ups to equipment. For equipment mounted on outdoor concrete pads, extend conduit and terminate with end bell a minimum of 3" above pad.

G. Sealing: Provide temporary closure at terminations of ducts that are wired under this

Project. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15 psi hydrostatic pressure.

H. Expansion Fittings: Provide PVC expansion fittings, suitable for exterior use, in all PVC conduit runs where conduit emerges from underground and terminates in a fixed box, panel, switch, meter socket, etc., per NEC 352.44. Install with fixed barrel end up (above) the moveable piston, to prevent water collection in the seal. Set piston location within barrel based on current ambient temperature per manufacturer's instructions.

I. Pulling Cord: Install 200-pound-test nylon cord in ducts, including each and every spare.

J. Buried Utility Marker Tape installed 12" below grade above every ductbank and buried conduit.

K. For direct buried 600 volt electrical circuits:

1. Burial depth as required by NEC Article 300-5 and Table 300-5.
2. Minimum separation from other utilities of 18."

L. Ductbank Burial Depth and Separations:

1. Top of envelope below grade - minimum as follows:
   a. 36 inches – Primary Conduits
   b. 30 inches – Secondary Conduits
   c. 30 inches – Generator Conduits
2. Separation from other buried utilities as follows:
   a. All utilities: 24"

M. Ductbank stubouts:

1. Five feet out from manholes, minimum.
2. Do not terminate under other ducts, concrete pads, pipes, etc. Extend stubout 5 feet past obstacle.
3. Extend PVC ducts and rebar 18" past end of concrete to allow future tie in.
4. Cap and seal all ducts to prevent water penetration.

3.4 HANDHOLE INSTALLATION

A. General:

1. Install approximately where shown and where required for underground conduit runs exceeding 150LF. Exact location of each handhole shall be determined after careful consideration has been given to the location of other utilities, grading and paving.
2. The location of each handhole shall be staked in field and approved before setting the handhole.
3. Coordinate exact placement and elevation based on local grade, slope, other utilities, fences, roads and walkways, etc. which may affect location.
4. Set level, and adjust for final, surrounding grade, such that lid is even with surrounding asphalt, concrete or soil.

B. Conduit and Duct Connections:

1. Sidewall conduit penetrations shall be sealed with grout or waterproof sealant.
2. All conduit ends shall have bell fittings, or nylon or plastic bushings to prevent damage to wire insulation when pulling.

C. Handhole Drainage:

1. Set handholes on minimum 6-8" layer of clean, compacted gravel or stone for drainage (no dust).
2. Provide filter fabric, placed between gravel and earth below handhole, and wrapped up along sides to prevent contamination of stone.

3.5 CONSTRUCTION

A. Excavation and Backfilling:

1. Perform all excavating and backfilling necessary to install underground ductbanks, manholes, cables, etc., included in this Division of the work. Excavation and back fill shall be performed in accordance with the requirements specified under Site Work Divisions.

B. Cutting and Patching:

1. Provide all cutting and patching necessary for the installation of the electrical work. Any damage done to the work already in place by reason of this work, shall be repaired at the Installer's expense by a qualified mechanic experienced in such work. Patching shall be uniform in appearance and shall match with the surrounding surface.

C. Grounding:

1. Refer to Section “Grounding & Bonding For Electrical Systems” for specific requirements.

3.6 FIELD QUALITY CONTROL

A. General:

1. Inspect all installed work after completion of rough and final grading to ensure no damage has occurred to installed components.
2. Ensure final grading matches elevation of all installed components. Make adjustments, as required, to correct for settling, etc.
3. Verify all handhole and manhole lid logos match the contained systems.

3.7 ADJUSTING

A. General:

1. Make adjustments to manhole or handhole lid elevations to match final grades.
2. Where lids will more than 1 inch lower than surrounding final grade, concrete, or asphalt, make adjustments to structure elevation, collar height, grading or concrete/asphalt installation to provide matched elevations.

3.8 CLEANING

A. Manholes & Handholes:

1. Remove all wire clippings, tape, loose debris, etc. from inside of all manholes and handholes.

B. Ducts & Conduit:

1. After installation, but prior to installing cables, pull a mandrel sized ¼" less than conduit ID to confirm no blockages or collapsed ducts.
2. Clean each installed conduit with a stiff brush to remove debris.

END OF SECTION

SECTION 26 05 48

VIBRATION & SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. This Section includes vibration and seismic control for electrical fire protection and life safety systems, conduit, wiring and equipment. It is the intent of the seismic portion of this specification to keep all required mechanical and electrical building system components in place during a seismic event.

B. The requirements for seismic protection measures to be applied to electrical, fire alarm and life safety equipment and systems specified herein are in addition to any other items called for in other Sections of the Specifications. Provide seismic bracing for equipment and systems within the project area. Seismic forces shall be calculated by a qualified Licensed Professional Engineer. Seismic bracing and anchors shall be designed by the Licensed Professional Engineer to withstand the calculated seismic forces per the specified project conditions.

C. All components mounted outside of the building envelope (on-grade, on roof, on exterior walls, etc.) shall be mounted and supported to resist wind loads as required by the International Building Code (IBC), edition in effect by local authority having jurisdiction. Vibration and seismic controls shall be provided for all exterior equipment with $I_P > 1.0$ (including generators, ATS, etc.)

D. Section Includes:
1. Materials
2. Seismic Restraints
3. Vibration Isolation Mount Types
4. Equipment Bases
5. Resilient Penetration Sleeve/Seal
6. Seismic Snubber
7. Flexible conduit/raceway sections
8. Flexible Electrical Connection
9. Restraints
10. Grommets
11. Acoustical Sealant
12. Vibration Isolation Schedule

E. Related Sections:

1. Section “Common Work Results for Electrical” for other requirements of anchors, supports, equipment pads, etc.
2. Section “Low Voltage Electrical Power Conductors and Cables”
3. Section “Raceways and Boxes for Electrical Systems” for conduit and other materials requiring special and/or additional bracing and anchoring.

4. Section “Packaged Generator Assemblies” for generator equipment requiring special anchoring.
5. Section “Low Voltage Electrical Distribution” for switchgear and other equipment requiring special anchoring and bracing.
6. Section “Low Voltage Transformers” for transformers requiring special anchoring and bracing.
7. Section “Transfer Switches” Section “Transfer Switches” for equipment requiring special anchoring and bracing.
8. Section “Lighting” for fixtures and equipment requiring special supports and bracing.

1.3 DEFINITIONS

A. IBC International Building Code

B. Seismic Restraint: A fixed device (a seismic brace, an anchor bolt or stud, or a fastening assembly) used to prevent vertical or horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.

C. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independent of other mobile structural elements during an earthquake.

D. Life Safety Systems:

1. All systems involved with fire detection and alarm.
2. All systems involved with power, control, actuation or monitoring of fire pumps, smoke exhaust fans, stair/elevator pressurization fans, smoke dampers.
3. All electrical power, control and/or monitoring systems associated with emergency generators, transfer switches and emergency power distribution, including panelboards, dry transformers, raceways, etc.
4. All electrical power systems associated with emergency egress and exit lighting.
5. All electrical and/or monitoring systems involved with and/or connected to elevators, when provided with emergency power.

1.4 SYSTEM DESCRIPTION

A. Performance Requirements: This is a performance specification. It is the full responsibility of the installer to insure that the design and installation conforms to all applicable standards and Codes.

1.5 SUBMITTALS

A. Submittal Requirements of this section:

1. Illustrate and indicate types, styles, materials, strength, fastening provisions, and finish for each type and size of seismic restraint component used.

B. Descriptive Data:

1. Manufacturer's specifications, data sheets.
2. Catalog cuts.
3. Dimensional drawings.
4. Installation Instructions.

5. Capacity ratings, performance curves.
6. Information required to indicate contract compliance.
7. Clearly indicate the exact size or rating proposed.
8. Anchor Bolts and Studs: Tabulate types and sizes, complete with report numbers and rated strength in tension and shear as evaluated by an agency approved by authorities having jurisdiction.

C. Product Certificates: Signed by manufacturers of seismic restraints certifying that products furnished comply with requirements.

D. Shop Drawings: For anchorage and bracing not defined by details and charts on Drawings. Indicate materials, and show designs and calculations signed and sealed by a professional engineer.

1. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
2. Details: Detail fabrication and arrangement. Detail attachment of restraints to both structural and restrained items. Show attachment locations, methods, and spacings, identifying components and listing their strengths. Indicate direction and value of forces transmitted to the structure during seismic events.
3. Preapproval and Evaluation Documentation: By agency or testing firm acceptable to the AHJ, showing maximum ratings of restraints and the basis for approval (tests or calculations).

E. Material Test Reports: From a qualified testing agency indicating and interpreting test results of seismic control devices for compliance with requirements indicated.

F. Seismic Certification and Analysis:

1. Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.
2. All restraining devices shall have a preapproval number from California OSHPD or some other recognized government agency showing maximum restraint ratings. Preapprovals based on independent testing are preferred to preapprovals based on calculations. Where preapproved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of the job location. Testing and calculations must include both shear and tensile loads as well as one test or analysis at 45E to the weakest mode.
3. Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in section 1.5 acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

G. Coordination Drawings: Plans and sections drawn to scale and coordinating seismic bracing for electrical components with other systems and equipment, including other seismic restraints, in the vicinity.

H. Closeout Submittals: Submit in accordance with the General Conditions and Division 01 requirements, Section “Common Work Results For Electrical”, and as follows:

1.6 QUALITY ASSURANCE

A. Comply with seismic restraint requirements within the jurisdiction of the project, unless requirements in this Section are more stringent.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing seismic engineering services, including the design of seismic restraints, that are similar to those indicated for this Project.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.

D. Single-Source Responsibility:

1. The complete performance of the assembled system, including all accessories shall be the sole responsibility of the supplier. It is the installer’s responsibility to ensure that all factory and field installed accessories and loose components used in the system, meet these specifications, and perform up to the stated and tested standards.

E. Installer Qualifications:

1. The installer shall be fully trained and knowledgeable in the application and installation of seismic controls, or shall employ a firm with such capabilities to perform the work of this section.

F. Installation Quality: In accordance with recognized trade organizations and standards.

1. NEMA.
2. ANSI.
3. NECA (National Electrical Contractor’s Association) “Standards of Installation”
4. NEMA (National Electrical Manufacturer’s Association).

1.7 PROJECT CONDITIONS

A. Building Occupancy Category for Structural Design per IBC 1604.5: Risk Category IV

B. Seismic Design Category: A

C. Site Class: C

1.8 COORDINATION

A. Coordinate layout and installation of seismic bracing with building structural system and architectural features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.

B. Coordinate concrete bases with building structural system.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Structural Steel Channel
   a. Cooper B-Line Systems, Inc.
   b. Mason Industries, Inc.
   c. Unistrut Corporation.

2.2 MATERIALS:

A. Use the following materials for restraints.

1. Indoor Dry Locations: Steel, zinc plated.
2. Outdoors and Damp Locations: Galvanized steel.
3. Corrosive Locations: Stainless steel.

2.3 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Coordinate products in this Article with structural engineer and with Drawings.

B. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

C. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type.

D. Concrete Inserts: Steel-channel type.

E. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

F. Welding Lugs: Comply with MSS SP-69, Type 57.

G. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.

H. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.4 SEISMIC BRACING COMPONENTS:

A. Slotted Steel Channel: 1-5/8 x 1-5/8-inch cross section, formed from 0.1046-inch thick steel, with 9/16 x 7/8-inch slots at a maximum of 2 inches on center in webs, and flange

edges turned toward web.

1. Materials for Channel: ASTM A 570, GR 33.
2. Materials for Fittings and Accessories: ASTM A 575, ASTM A 576, or ASTM A 36.
3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.

B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.

PART 3 EXECUTION

3.1 INSTALLATION

A. General Requirements:

1. Install seismic restraints according to applicable codes and regulations and as approved by authorities having jurisdiction, unless more stringent requirements are indicated.

B. Structural Attachment:

1. Use bolted connections with steel brackets, slotted channel, and slotted-channel fittings to spread structural loads and reduce stresses.
2. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.
3. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.
4. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.
5. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.
6. Attachments to Wood Structural Members: Install bolts through members.
7. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.

C. Electrical Equipment Anchorage:

1. Coordinate with Sections specifying products referenced in paragraphs below. See Evaluations.
2. Anchor rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.
3. Anchor panelboards, motor controls, transformers, transfer switches, and distribution units as follows:
   a. Size concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.
   b. Concrete Bases for Floor-Mounted Equipment: Use female expansion anchors and install studs and nuts after equipment is positioned.
   c. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.
   d. Torque bolts and nuts on studs to values recommended by equipment

manufacturer.

D. SEISMIC BRACING INSTALLATION:

1. Expansion and Contraction: Install to allow for thermal movement of braced components.
2. Cable Braces: Install with maximum cable slack recommended by manufacturer.
3. Attachment to Structure: If specific attachment is not indicated, anchor bracing to the structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

3.2 CONSTRUCTION

A. Accommodation Of Differential Seismic Motion:

1. Make flexible connections in raceways, cables, wireways, cable trays, and busways where they cross expansion and seismic control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate at electrical equipment anchored to a different mobile structural element from the one supporting them.

3.3 FIELD QUALITY CONTROL

A. General:

1. Perform inspections and testing to ensure installation complies with Contract Documents, performance is within industry and manufacturer's tolerances, is adjusted to specific project parameters.
2. Schedule tests and provide notification at least one week in advance of test commencement.
3. Provide a set of Contract Drawings to the testing agency.
4. Provide manufacturer's installation and testing instructions to the testing agency.
5. Provide complete shop drawing data on all equipment.
6. Provide written results of all tests. Include date, equipment ID, name of testing company and technician, and results of each individual test. Provide pass/fail indication for each test.

B. Pre-Testing Inspections:

1. Inspect accessible components for cleanliness, mechanical, and electrical integrity, for presence of damage or deterioration, and to ensure removal of temporary shipping bracing. Do not proceed with tests until deficiencies are corrected.
2. Inspect bolted electrical connections for tightness according to manufacturer's published torque values.

C. Acceptance Testing: Provide for acceptance testing of seismic bracing specified in this section, as follows.

1. Testing Agency: Engage a qualified testing agency to perform the following field quality-control testing:

D. Acceptance Tests: Test pull-out resistance of seismic anchorage devices.

1. Provide necessary test equipment required for reliable testing.
2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
3. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
4. Obtain Architect's approval before transmitting test loads to the structure. Provide temporary load-spreading members.
5. Edit sampling frequency in subparagraph below to suit Project.
6. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
7. Test to 90 percent of rated proof load of device.
8. If a device fails the test, modify all installations of same type and retest until satisfactory results are achieved.
9. Record all test results and include in project O&M Manuals.

END OF SECTION

SECTION 26 05 73

OVERCURRENT PROTECTIVE DEVICE COORDINATION, SHORT CIRCUIT & ARC FLASH STUDY

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. The contractor shall furnish the following engineering studies as part of this contract:

1. Short Circuit & Device Evaluation Study
2. Overcurrent Protective Device Coordination Study
3. Arc Flash Hazard Analysis Study

B. The study(ies) shall be prepared by the major electrical equipment manufacturer, or an approved professional engineering firm, registered in the State of Maryland, to perform all the required calculations and studies, required by this section.

C. The Arc Flash Hazard Analysis Study shall be performed per the requirements set forth in NFPA 70E - Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the latest version of IEEE 1584 equations that are presented in NFPA 70E (current edition), Annex D.

D. The scope of the studies shall include all new distribution equipment supplied by the equipment Manufacturer and installed under this contract, as well as all directly affected existing distribution equipment at the customer facility.

E. The type and content of each study is specified in the following sections.

1.2 ELECTRONIC AUTOCADD DOCUMENTS

A. Requests for electronic Autocadd documents will be accommodated to the contractors and installers upon receipt of Bowman’s Electronic Document Release Form. Refer to Section “Common Work Results for Electrical” for additional information.

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
6. IEEE 1584 - Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):
1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

C. The National Fire Protection Association (NFPA)
1. NFPA 70 - National Electrical Code, latest edition
2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.4 QUALIFICATIONS

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Professional Electrical Engineer, registered in the state of where the project is located. The Engineer shall be skilled in performing and interpreting the power system studies.

B. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer, or an approved engineering firm.

C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies. The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis completed in the past two years, upon request.

1.5 COMPUTER ANALYSIS SOFTWARE

A. The studies shall be performed using a computer simulation software package, specifically designed for short circuit, coordination and arc flash studies. Utilize the latest revision of the SKM Systems Analysis Power*Tools for Windows (PTW) software program, or an approved equal.

1.6 SUBMITTALS

A. General: Submit items in this Section according to the conditions of the contract and Division 01 Specification Sections.

B. Submittals shall also comply with the submittal procedures and requirements of electrical Specification Sections.

C. The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawing submittals, and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

D. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. Bound copies of the report shall be submitted for review and approval. The short-circuit input and output data shall be included in the report. The report shall include the following sections:

1. Executive Summary.
2. Descriptions, purpose, basis and scope of the study
3. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties
4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selections
5. Fault current calculations including a definition of terms and guide for interpretation of the computer printout
6. Details of the incident energy and flash protection boundary calculations
7. Recommendations for system improvements, where needed
8. One-line diagram
9. Arc flash labels in hard paper copy. Adhesive labels shall be installed on all panels at completion of project.

E. Provide electronic copies (in PDF format) of the completed protective device time-current coordination analysis to the Owner and Architect for review and approval.

F. The contract shall provide for corrections, adjustments, etc. as identified during the Architect's review of the initial report. A resubmission of the report shall be made to address all issues.

PART 2 PRODUCTS

2.1 STUDIES:

A. Contractor to furnish short-circuit and protective device coordination studies, as prepared by equipment manufacturer, or an approved engineering firm.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E – Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

2.2 DATA COLLECTION

A. Contractor shall obtain and furnish all data as required by the power system studies. The firm or Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source combination shall include present and future motors ($\geq$ 50HP) and all emergency generators.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor.

D. If applicable, include fault contribution of existing motors ($\geq$ 50HP) in the study. The Contractor shall obtain required existing equipment data, as necessary, to satisfy the study requirements.

2.3 SHORT-CIRCUIT AND DEVICE EVALUATION STUDY

A. The study shall originate at the incoming utility company BGE service connection in the customer-owned C/T Cabinet and shall include:

1. Main secondary or secondary service breaker(s).
2. Low voltage panels.
3. Low voltage transformers.
4. Disconnect switches.
5. Enclosed circuit breakers.
6. Emergency Generators.
7. Automatic transfer switches.
8. Portable Generator Docking stations.
9. Elevator disconnect switches or breakers.
10. Other equipment as noted.

B. Input Data:

1. Use actual conductor impedances, if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.
2. Transformer design impedances shall be used when manufacturer's test impedances are not available. Use nameplate impedances for all existing transformers.
3. The contractor shall be responsible for supplying conductor information (lengths, types, number per phase, etc.) in a timely manner to allow the short-circuit analysis to be completed prior to final installation.
4. Include the actual parameters of the proposed or existing emergency generator(s) in the study.

C. Provide the following:

1. Calculation methods and assumptions
2. Selected base per unit quantities
3. One-line diagram of the system being evaluated
4. Source impedance data, including electric utility system contribution characteristics
5. Tabulations of calculated quantities
6. Results, conclusions, and recommendations.

D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each equipment bus or connection lugs:
1. Main secondary or secondary service breaker(s) or fusible switches.
2. Outgoing feeder breakers or fusible switches in panelboard(s) with trip ratings/settings $\geq$ 60 amps.
3. Low voltage panelboards.
4. Low voltage transformers.
5. Disconnect switches $\geq$ 60 amps
6. Enclosed circuit breakers $\geq$ 60 amps
7. Emergency Generators and output breaker(s) of any rating.
8. Automatic transfer switches.
9. Portable Generator Docking stations.
10. Elevator disconnect switches or breakers of any rating.
11. Other equipment as noted.

E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

F. Study Report Content:

1. The study shall include a computer printout of input circuit data including conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.
2. A tabular computer printout shall be included which lists the calculated short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings, and notes regarding the adequacy or inadequacy of the equipment sizes and ratings.
3. Include a bus-to-bus computer printout identifying the maximum available short-circuit current in rms symmetrical amperes and the X/R ratio of the fault current for each bus-to-bus calculation.
4. The system one-line diagram shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis.

G. Overcurrent Protective Device Evaluation:

1. Provide evaluation of the adequacy or inadequacy of the distribution system equipment, based on calculated short circuit ratings.
2. Evaluate all equipment and protective devices and compare to short circuit ratings as designed.
3. Adequacy of switchgear, switchboards, switches, circuit breakers, and or panelboard bus bars to withstand short-circuit stresses.
4. Provide clear indication where specified/designed ratings are not sufficient to interrupt calculated fault currents.

2.4 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

A. The Overcurrent Protective Device Coordination Study shall use the applicable information from the Short Circuit Study, and shall include:

1. Main secondary or secondary service breaker(s) or fused switch(es).
2. Outgoing feeder breakers or fused switches in panelboard(s) with trip ratings/settings $\geq$ 100 amps.
3. All OCP deevices in the life safety emergency power system.
4. Panels and breaker downstream of ATS-LS.
5. Disconnect switches $\geq$ 100 amps
6. Enclosed circuit breakers $\geq$ 60 amps
7. Generator output breaker(s) of any rating and protection settings, as recommended by manufacturer, and coordination with other relays, settings, etc. of the equipment.
8. Automatic transfer switches.
9. Portable Generator Docking station breaker(s).
10. Elevator disconnect switches or breakers of any rating.
11. Ground fault protection device settings on all above equipment.
12. Motor starters and downstream motors for motors rated $\geq$ 25 HP.
13. Other equipment as noted.

B. Time Current Curves:

1. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
2. Include on each TCC graph, a complete title and applicable one-line diagram with legend identifying the specific portion of the system covered.
3. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
4. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
5. Plot the following characteristics on the TCC graphs, as applicable:
   a. Electric utility's available faut current and overcurrent protective devices
   b. LV fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
   c. LV Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection damage curves
   d. LV conductor damage curves
   e. Generator short circuit and protection device curves
   f. Elevator motor starting curves with applicable starter type(s).
   g. Motor starting curves with applicable starter type(s).
   h. All ground fault protective devices, as applicable.

C. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

1. A sufficient number of computer generated log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
2. Computer printouts shall accompany the log-log plots containing descriptions for each of the devices shown, settings of the adjustable devices, the short-circuit current availability at the device location when known, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.
3. The study shall include a separate, tabular computer printout containing the suggested device settings of all adjustable overcurrent protective devices, the equipment where the device is located, the device number corresponding to the device on the system one-line diagram, and the number of the time-current log-log graphs where they are illustrated.

D. Study Summary & Report:

1. A comprehensive discussion section evaluating the overall system coordination, areas of reduced protection or coordination and areas where either coordination and/or protection is not adequate.
2. Provide recommendations, as required for increasing system protection or device coordination, and reasoning for selecting protection or coordination over the other.
3. Where necessary, an appropriate compromise shall be made between system protection and service continuity with system protection and service continuity considered to be of equal importance. All such assumptions shall be clearly identified in the report with the proposed solution approach.
4. Significant deficiencies in protection and/or coordination shall be called to the attention of the Architect, and recommendations made for improvements as soon as any they are identified.

2.5 ARC FLASH HAZARD ANALYSIS STUDY

A. The Arc Flash Hazard Analysis Study shall include all new and existing equipment shown on the drawings including the following:

1. Distribution panelboards.
2. Branch circuit panelboards.
3. Disconnect switches ≥ 60 amps.
4. Enclosed circuit breakers ≥ 60 amps.
5. Generators and associated output breaker(s) of any rating.
6. Automatic transfer switches.
7. Portable Generator Docking station.
8. Elevator disconnect switches or breakers of any rating.
9. Enclosed motor starts rated ≥ 60 amps.
10. Other equipment as noted.

B. The flash protection boundary and the incident energy shall be calculated in the electrical distribution system (at locations listed above) where work could be performed on energized parts.

C. Safe working distances shall be based upon the calculated arc flash boundary considering incident energy of 1.2 cal/cm².

D. When appropriate, the short circuit and the clearing times of the phase overcurrent devices will be retrieved from the short circuit and coordination study model.

E. The short circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating.

F. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on busses with multiple sources. Iterative calculations must take into account the changing current contributions, as sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay 10 per unit to 3 per unit after 10 cycles).

G. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

H. When performing incident energy calculations of the line side of a mina breaker (as required per above), the line side and load side contributions must be included in the fault

calculation.

I. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

J. Arc Flash calculations shall be based on the actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2018 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific locations shall be utilized.

K. The report shall include incident energy and flash protection boundary calculations:

1. Arc fault magnitude
2. Protective device clearing time
3. Duration of arc
4. Arc flash boundary
5. Working distance
6. Incident energy
7. Hazard Risk Category
8. Recommendation for arc flash energy reduction

L. The contractor of the Arc Flash Hazard Analysis shall provide a 3.5 in x 5 in thermal transfer type label of high adhesion polyester for each equipment and work location analyzed.

M. All labels shall be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.

N. The labels shall include the following information, at a minimum: location designation, nominal voltage, flash protection boundary, hazard risk category, incident energy, working distance, engineering report number, revision number and issue date.

O. Labels shall be machine printed, with no field markings

P. The contractor of the Arc Flash Hazard Analysis shall train the owners qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum 4 hours). The training shall be certified for continuing education units (CEU's) by the International Association for Continuing Education Training (ACET) or equivalent

PART 3 EXECUTION

3.1 GENERAL

A. Studies are to be completed prior to release of any distribution equipment included in or affected by the studies. If any changes to specified ratings are required as a result of the study(ies), the changes shall be identified prior to order release. The owner shall not be responsible for costs related to equipment returns, restocking fees, removal and reinstallation, etc. of equipment ordered or installed prior to completion of study(ies).

3.2 INSTALLATION

A. Contractor shall be responsible for verifying installed equipment matches the equipment used as the basis for the studies. Where differences exist, the contractor shall notify the Engineer which performed the studies and obtain corrected settings applicable to the installed equipment.

B. Arc Flash Identification Labels:

1. Contractor shall affix all Arc Flash Hazard labels to all equipment.
2. Clean surface prior to applying labels.
3. Apply labels, per NFPA 70E, level and without air bubbles or wrinkles.
4. Do not affix labels over screws or hardware such that labels will be damaged during removal of equipment covers, etc.

3.3 FIELD QUALITY CONTROL

A. General:

1. Provide a set of approved Study documents to the distribution system testing agency.
2. All settings, as specified in the report, shall be properly set and verified prior to equipment testing.

3.4 ADJUSTING

A. Relay settings, breaker interrupting rating, bus bracing shall be minimum as shown on drawings and specifications. Final settings and sizing shall be according to the approved short circuit and coordination studies

B. Set all field adjustable circuit breaker parameters.

C. Set field adjustable pickup and time delay ranges of Ground Fault Systems and solid state breakers.

Fuses: Provide fuses, installed in fusible switches, switchgear, etc.

END OF SECTION

SECTION 26 08 00

ELECTRICAL SYSTEMS COMMISSIONING

PART 1 GENERAL

1.01 DESCRIPTION

A. The purpose of this section is to specify Division 26 responsibilities in the commissioning process which are being directed by the Commissioning Authority (CxA). Other electrical systems testing may be required under the direction of the General Contractor (GC).

B. The list of commissioned equipment and systems is found in Section 01 75 00.

C. Commissioning requires the participation of Division 26 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 01 75 00. Division 26 shall be familiar with all parts of Section 01 75 00 and the commissioning plan issued by the CxA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

1.02 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

D. Refer to section 017500 for additional definitions related to the commissioning process.

1.03 INFORMATION SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

C. All third party reports and test information required by other Division 26 Sections.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: As specified in each Section containing electrical testing requirements and in subparagraph and associated subparagraph below:
   1. Independent Testing Agencies: Independent of manufacturers, suppliers, and installers of components to be tested or inspected.
      a. Testing Agency's Field Supervisor for Power Component Testing: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Division 26 power component Sections.
   2. Test Equipment Suitability: Comply with NETA ATS, Section 5.2
   3. Test Equipment Calibration: Comply with NETA ATS, Section 5.3

1.05 RESPONSIBILITIES

A. The commissioning responsibilities applicable to the electrical contractor are as follows (all references apply to commissioned equipment):
   1. Construction and Acceptance Phases
      a. Attend a commissioning scoping meeting and other necessary meetings scheduled by the CxA to facilitate the Cx process.
      b. Contractors shall provide normal cut sheets and shop drawing submittals to the CxA of commissioned equipment.
      c. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of startup and functional testing procedures.
         1) Typically this will include detailed manufacturer installation and startup, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, full factory testing reports, if any,

and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CxA.

2) The CxA may request further documentation necessary for the commissioning process.
3) This data request may be made prior to normal submittals.

d. Provide a copy of the O&M manuals submittals of commissioned equipment, through normal channels, to the CxA for review.
e. Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, drawings or equipment documentation is not sufficient for writing detailed testing procedures.
f. Provide assistance to the CxA in preparation of the specific functional performance test procedures. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
g. Develop a full startup and initial checkout plan using manufacturer's startup procedures and the pre-functional checklists from the CxA. Submit manufacturer's detailed startup procedures and the full startup plan and procedures and other requested equipment documentation to CxA for review.
h. During the startup and initial checkout process, execute and document the electrical related portions of the pre-functional checklists provided by the CxA for all commissioned equipment.
i. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.
j. Address current A/E punch list items before functional testing.
k. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
l. Perform functional performance testing under the direction of the CxA for specified equipment in Section 26 08 00 and 01 75 00. Assist the CxA in interpreting the monitoring data, as necessary.
m. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA, GC and A/E and retest the equipment.
n. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
o. During construction, maintain as-built red-line drawings for all drawings and final CAD as-built for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing). Prepare red-line as-built drawings for all drawings and final as-builts for contractor-generated coordination drawings.
p. Provide training of the Owner's operating personnel as specified.
q. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

2. Warranty Period
   a. Execute deferred functional performance testing, witnessed by the CxA, according to the specifications.
   b. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

1.06 COMMISSIONING DOCUMENTATION

A. Contractor to provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for Division 23 systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that Division 23 systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.

1.07 RELATED WORK

A. Refer to Section 01 75 00 for a listing of all sections where commissioning requirements are found.

B. Refer to Section 01 75 00 and Section 3.9 for systems to be commissioned and functional testing requirements.

C. The Div. 26 contractor shall provide all labor and materials to fully support Div. 23 HVAC systems start up field quality control, pre-commissioning and commissioning. The Div. 26 contractor shall perform all required electrical portions of the Div. 23 commissioning. As part of this requirement, indicate by signature when check list items are complete where so indicated in the Div. 23 checklists.

D. Coordinate all provisions and installations of Div. 23 with the hardware schedule indicated on the Architectural drawings.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. Division 26 shall provide all test equipment necessary to fulfill the testing requirements of this Division.

B. Refer to Section 01 75 00 for additional Division 26 requirements.

PART 3 EXECUTION

3.01 STARTUP

A. The electrical contractors shall follow the startup and initial checkout procedures listed in the Responsibilities list in this section and in 01 75 00. Division 26 has startup responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning agent or Owner.

B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems, or sub-systems at the discretion of the CxA and GC. Beginning system testing before full completion does not relieve the Contractor of responsibility for fully completing the system, including all pre-functional checklists as soon as possible.

C. A representative pre-functional checklist (PFC) can be provided by request to illustrate the format and rigor of testing required for this section. Similar checklists will be developed by the CxA for all other equipment to be commissioned as listed in Section 01 75 00.

3.02 GENERAL TESTS AND INSPECTIONS

A. If a group of tests are specified to be performed by an independent testing agency, prepare

systems, equipment, and components for tests and inspections, and perform preliminary tests to ensure that systems, equipment, and components are ready for independent agency testing. Include the following minimum preparations as appropriate:

1. Perform insulation-resistance tests.
2. Perform continuity tests.
3. Perform rotation test (for motors to be tested).
4. Provide a stable source of single-phase, 208/120-V electrical power for test instrumentation at each test location.

B. Test and Inspection Reports: In addition to requirements specified elsewhere, report the following:
   1. Manufacturer's written testing and inspecting instructions.
   2. Calibration and adjustment settings of adjustable and interchangeable devices involved in tests.
   3. Tabulation of expected measurement results made before measurements.
   4. Tabulation of "as-found" and "as-left" measurement and observation results.
   5. Tabulate the calculated and measured voltage drop to each panelboard and large equipment.

C. Feeders:
   1. Include in testing, ground, resistance, conducting, and torque testing on all newly installed feeders. This applies to all feeders to panelboards and individual pieces of HVAC equipment.
   2. Test shall be from and including lugs of originating source to terminal lugs @ equipment listed above.
      a. Test ground continuity throughout circuit per NETA Standards.
      b. Test resistivity of insulation for each feeder conductor per tables and text in NETA Standards.
      c. Test and verify conductance per NETA Standards, wire manufacturers recommendations, and applicable U.L. Standards. Check torque at all lugs. Retorque where appropriate ft. pound valve at termination does not meet cable manufacturer specifications, U.L. standards for tested cable, and NETA Test Standards.
      d. Contractor shall also adhere to my requirements of the Loudoun County Building Officials with respect to feeder requirements.
   3. The Contractor shall record in writing the results for each test parameter at each feeder and submit to the Owner, CxA and the EOR prior to beginning any work in subject panelboard.
   4. The Contractor includes in bid price, the full services of a certified, independent electrical testing organization approved by the Owner. The independent testing organization must be certified and have ten (10) or more years in demonstrated experience in testing and analyzing conditions and performance of all items within the scope of work.
   5. Voltage Drop: Calculate, then measure the voltage drop at all feeders from the switchboard through the system to each panelboard.
   6. Where large equipment is connected, measure the voltage drop to the equipment at full load.

3.03 FUNCTIONAL PERFORMANCE TESTS

A. Refer to Section 01 75 00 for a list of systems to be commissioned.

B. A representative functional performance test (FPT) can be provided to illustrate the format and rigor of testing required for this section. Similar checklists will be developed by the CxA for all other equipment to be commissioned as listed in Section 01 75 00.

C. This section shall not exempt contractual requirements to perform other tests, etc. throughout each and every Division 26 Specification section.

D. This Section includes general requirements for electrical field testing and inspecting. Without exception, the Contractor is responsible and bid price includes all testing referenced within this section and all other Div. 26 sections. General requirements include the following:
   1. Qualifications of testing agencies and their personnel.
   2. Suitability of test equipment.
   3. Calibration of test instruments.
   4. Coordination requirements for testing and inspecting.
   5. Reporting requirements for testing and inspecting.

E. Additional tests will be developed for other systems listed in Section 3.9 based on final electrical system design and submitted and approved products.

3.04 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

A. Refer to Section 01 75 00 for specific details on non-conformance issues relating to pre-functional checklists and tests.

B. Refer to Section 01 75 00 for issues relating to functional performance tests.

3.05 OPERATIONS AND MAINTENANCE (O&M) MANUALS

A. Division 26 shall compile and prepare documentation for all equipment and systems covered in Division 26 and deliver to the GC for inclusion in the O&M manuals, according to the specifications.

B. The CxA shall receive a copy of the O&M manuals for concurrent review.

3.06 TRAINING OF OWNER PERSONNEL

A. The GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed. Refer to Section 01 75 00 for additional details.

B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment. Refer to Section 01 75 00 for additional details.

C. The electrical contractor shall have the following training responsibilities:
   1. Provide the CxA with a training plan eight (8) weeks before the planned training according to the outline described in Section 01 75 00.
   2. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.
   3. Training shall start with classroom sessions, if necessary, followed by hands on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
   4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
   5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the startup technician for the piece of equipment, the installing contractor or manufacturer’s representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than one party may be required to execute the training.
   6. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
   7. Training shall include:
      a. Use the printed installation, operation and maintenance instruction material included in the O&M manuals.
      b. Include a review of the written O&M instructions emphasizing safe and proper

operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include startup, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

c. Discuss relevant health and safety issues and concerns.
d. Discuss warranties and guarantees.
e. Cover common troubleshooting problems and solutions.
f. Explain information included in the O&M manuals and the location of all plans and manuals in the facility.
g. Discuss any peculiarities of equipment installation or operation.
h. The format and training agenda in Guidelines for Commissioning HVAC Systems, ASHRAE, Guideline 0-2005 is recommended.
i. Classroom sessions shall include the use of overhead projections, slides, video and audio taped material as might be appropriate.

8. Hands-on training shall include startup, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.
9. The electrical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
10. Training shall occur after functional testing is complete, unless approved otherwise by the Project Manager.
11. Duration of Training: The electrical contractor shall provide training on each piece of equipment.
    a. Hours per System
        1) Lighting Controls - 4 hours
        2) Life Safety Systems - 14 hours
        3) Emergency power systems - 6 hours
12. Videotaping as described in Section 01 75 00.

3.07 DEFERRED TESTING

A. Refer to Section 01 75 00 for requirements of deferred testing.

3.08 WRITTEN WORK PRODUCTS

A. Written work products of Contractors will consist of the startup and initial checkout plan described in Section 01 75 00 and the filled out startup, initial checkout and pre-functional checklists.

3.09 SYSTEMS TO BE COMMISSIONED

A. The understanding should be that the commissioning agent intends to test all lighting and lighting controls with the participation of the electrical and lighting contractors.

SPEC. SECTION	SYSTEM DESCRIPTION	SAMPLING
	LIGHTING CONTROL DEVICES	100%
	INTERIOR LIGHTING	100%
	EMERGENCY POWER GENERATOR	100%

END OF SECTION

SECTION 26 08 10

ELECTRICAL ACCEPTANCE TESTING

PART 1 GENERAL

1.01 DESCRIPTION

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.03 GENERAL

A. The Contractor shall perform the tests as outlined below to insure system acceptance.

B. When the tests and inspections have been completed, a label shall be attached to all devices tested. The label shall provide the name of the testing company, the date the tests were completed, and the initials of the engineer who performed the tests.

C. The tests shall insure that the equipment is operational and functioning within industry standards and manufacturer's tolerances. Forward all test reports to the Architect at least two weeks prior to the project final inspection for review. Reports shall be bound as required by Division 1 of this specification.

1.04 QUALITY ASSURANCE

A. Industry Referenced Standards. The testing and inspection shall comply with all applicable sections of the following codes and standards:

1. American National Standards Institute - ANSI
2. American Society for Testing and Materials - ASTM
3. Association of Edison Illuminating Companies - AEIC
4. Institute of Electrical and Electronics Engineers - IEEE
5. Insulated Power Cable Engineers Association - IPCEA
6. International Electrical Testing Association - NETA Acceptance Testing Specifications
7. National Electrical Code - NEC
8. National Electrical Manufacturers Association - NEMA
9. National Fire Protection Association - NFPA
10. State and Local Codes and Ordinances
11. National Electrical Contractors' Association (NECA):
    a. Standards of Installation

B. The inspection and testing shall comply with the project plans and specifications as well as with the manufacturer's drawings, instruction manuals, and other applicable data for the apparatus tested.

1.05 SUBMITTALS

A. Refer to BASIC ELECTRICAL REQUIREMENTS for submittal requirements.

1.06 DIVISION OF RESPONSIBILITY

A. The Contractor shall:

1. Perform routine insulation-resistance, continuity, and rotation tests for all distribution and utilization equipment prior to and in addition to tests performed by the testing firm specified herein.
2. Supply a suitable and stable source of electrical power to each test site.

1.07 SAFETY AND PRECAUTIONS

A. Safety practices shall comply with applicable state and local safety orders as well as with

the Occupational Safety and Health Act of 1970 (OSHA). Compliance with the National Fire

Protection Association standard NFPA 70E and the Accident Prevention Manual for Industrial Operations of the National Safety Council shall be observed.

B. Tests shall only be performed on apparatus which is de-energized. The testing company's lead test engineer for the project shall be a designated safety representative and shall supervise testing observations and safety requirements. Work shall not proceed until he has determined that it is safe to do so.

C. Power circuits shall have conductors shorted to ground by a hotline grounded device approved for the purpose. Warning signs and protective barriers shall be provided as necessary to conduct the tests safely.

1.08 REPORTS

A. The test report(s) shall include the following sections:
   1. Scope of testing
   2. Electrical equipment tested
   3. Description of test procedures
   4. Test results
   5. Conclusions and recommendations
   6. Appendix, including test forms

B. Each piece of equipment shall be recorded on a data sheet listing the condition of the equipment as found and as left. Included shall be recommendations for any necessary repair and/or replacement parts. The data sheets shall indicate the name of the engineer who tested the equipment and the date of the test completion.

C. Record copies of the completed test report shall be submitted no more than 14 days after completion of the testing and inspection.

1.09 TEST EQUIPMENT

A. All test equipment shall be in good mechanical and electrical condition. All field instruments shall have been calibrated within six months of the testing date, and dated calibration labels shall be visible on the testing equipment. Submit calibration certification in the final report.

PART 2 PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

A. All materials are specified under other sections of this specification. All testing equipment required shall be provided under this section of the specifications.

PART 3 EXECUTION

3.01 EQUIPMENT TO BE TESTED

A. Equipment shall be tested in accordance with the following scopes of work.
   1. Dry Type Transformers
   2. Low Voltage Switchgear and Switchboards
   3. Lighting Control System
   4. Grounding System
   5. Cables, 600 Volts
   6. Ground Fault Systems

3.02 DRY TYPE TRANSFORMERS

A. Visual and Mechanical Inspection
   1. With case covers removed, inspect transformer core and coil assembly and enclosure interior. Cloth wipe and/or brush major insulating surfaces.
   2. Check primary, secondary, and ground connections.

3. Check tap connections and tap changer.
4. Inspect all bolted connections. The electrical contractor shall torque wrench tighten or remake any questionable connections.
5. Inspect insulators, spacers, and windings.
6. Inspect for adequate electrical clearance.
7. Check base or support insulators, including vibration isolation supports.
8. Check accessory devices for condition and proper operation.
9. Verify that the transformers have been provided with adequate spacing for ventilation.

B. Electrical Tests

1. Insulation Resistance Test: Megger transformer windings high to low and ground, low to high and ground, and high and low to ground.
2. Perform turns Ratio Test.
3. Where auxiliary cooling has been provided, verify proper operation of such equipment.
4. Include measured secondary voltage (line-to-line and line-to-ground) for each transformer in the test report. Verify that the taps on all transformers with primary voltages above 600 volts are set to deliver voltage indicated in the Contract Documents with the system in full operation. Secondary voltage readings, at each transformer, phase to phase neutral, and phase load readings shall be recorded and tap positions of transformer taps noted. This test shall be conducted with a calibrated voltmeter.
5. Each ground rod installation shall be tested after all connections to ground rods are made before grounding conductor connection is made to the transformer. Ground rod installations shall be tested by "fall of potential" measuring method using ground resistance test meter and two auxiliary electrodes driven into the earth, interconnected through the meter with the ground rod installation being tested.
6. Placement of auxiliary electrodes shall be in accordance with operating instructions of test meter, but in no case shall auxiliary current electrodes be placed within 70' of the grounding system being tested. Test data shall indicate placement of auxiliary electrodes with respect to systems being tested, date readings were taken and lowest resistance recorded.

3.03 LOW VOLTAGE SWITCHGEAR AND SWITCHBOARDS

A. Visual and Mechanical Inspection

1. Verify that the contractor has cleaned enclosure interiors of accumulated dust, dirt, oil films, and other foreign materials.
2. Inspect all electrical and mechanical components for condition and any evidence of defects or failure.
3. Check for proper travel and alignment of any drawout or plug-in circuit breakers.
4. Check breaker connections to bus.
5. Inspect bolted connections. The electrical contractor shall torque wrench tighten or remake any questionable connections. Refer to manufacturer's instructions for proper torque values.
6. Inspect for missing or loose hardware or accessories.
7. Inspect ground bus connections.
8. Operate key and door interlock devices to assure proper operation.
9. Inspect for labels, and nameplate compliance with up-to-date circuit connections.
10. Verify that potential transformers, including their overcurrent protection and current transformers, meet specified requirements.
11. Check switchboard anchorage, area clearances, and alignment and fit of components.

B. Electrical Tests

1. Insulation Resistance Test: Megger main secondary bus and feeder circuits phase-to-phase and phase-to-ground.
2. Energize any space heater circuits to insure proper operations.
3. Insulation resistance test of buses and portions of control wiring that disconnect from solid state devices through normal disconnecting features. Insulation resistance less than 100 megohms is not acceptable.

C. Check phase rotation with a Biddle phase rotation meter. Check phasing of alternate supply sources to the same bus.

D. Instruments and Meter Tests

1. Inspect panel mounted instruments and meters. Clean and check for calibration accuracy. Make minor adjustments as necessary.
2. Ratio and polarity tests on current and voltage transformers.
3. Calibrate ammeters and voltmeters at midscale. Use check instruments with documented up-to-date calibration traceable to NIST standards.
4. Verify appropriate capacity, overcurrent protection, and operating voltage of control power elements including control power transformer and control power wiring.
5. Calibrate watthour and demand meters to 0.5 percent, and verify meter multipliers. Use check instruments with documented up-to-date calibration traceable to NIST standards.

E. Infrared Scanning:

1. Use an infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. After Substantial Completion, but not more than 2 months after Final Acceptance, perform an infrared scan of switchboard bus joints and connections. Open or remove metal doors, covers, inspection plates, and barriers to make joints and connections accessible to a portable scanner.
3. Follow-up Infrared Scanning: Perform 2 additional follow-up infrared scans of the same joints and connections, one 4 months after Substantial Completion and one 11 months after Substantial Completion.
4. Record of Infrared Scanning: Report shall identify all connections checked and describe results of scanning. Include graphic indication of scanning results, notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.04 LIGHTING CONTROL SYSTEM

A. Visual and Mechanical Inspection

1. Inspect each device for physical damage.
2. Check for proper labeling of conductors
3. Inspect all system lamps and LED's for proper operation. Replace all non-operational equipment.
4. Check all cabinet doors, latches, and hinges for proper operation. Adjust, lubricate, and/or repair as required.

B. Electrical Tests

1. Verify the absence of unwanted voltages between circuit conductors and ground that would constitute a hazard or prevent proper system operation.
2. Meggar test all conductors (other than those intentionally grounded) for isolation from ground.
3. Test all conductors (other than those intentionally connected together) for conductor-to-conductor isolation using as insulation testing device.
4. The control unit shall be tested to verify it is in the proper operating condition as

detailed in the manufacturer's manual.

5. Each control circuit shall be tested to confirm proper operation of the circuit.

3.05 GROUNDING SYSTEM

A. Visual and Mechanical Inspection

1. Inspect wiring system outlet and junction boxes for proper grounding. Green grounding conductor shall be connected to outlet and junction boxes. Inspect a minimum of 5% of project boxes.
2. Verify connections of grounds for the secondary of separately derived grounding systems, i.e. at dry type transformers. Note type of connection, i.e. mechanical or exothermic.
3. Verify proper connection to all components of building service entrance grounding system. Note all system components which are interconnected and type of connection either mechanical or exothermic. Note depth of driven ground rods.

B. Electrical Tests

1. Perform ground-impedance measurements utilizing the fall-of-potential method per ANSI/IEEE Standard 81 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System". Instrumentation utilized shall be specifically designed for ground impedance testing. Provide sufficient spacing so that plotted curves flatten in the 62% area of the distance between the item under test and the current electrode.
2. When sufficient spacing of electrodes described above is impractical, perform ground-impedance measurements utilizing either the intersecting curves method or the slope method. (Ref. Nos. 40 and 41 in IEEE Std. 81.)

C. Equipment Grounds

1. Utilize two-point method of IEEE Std. 81. Measure between equipment ground being tested and known low-impedance grounding electrode or system.

D. Test Values

1. The main ground electrode system impedance-to-ground should be no greater than five (5) ohms for commercial or industrial systems and one (1) ohm of less for generating stations, transmission stations, and large industrial systems. Equipment grounds, depending on size and length of grounding conductor, should be only fractionally higher than system ground.

3.06 CABLES - 600V

A. Visual and Mechanical Inspection

1. Inspect cables for physical damage and proper connection in accordance with single-line diagram.
2. Test cable mechanical connections to manufacturer's recommended values using a calibrated torque wrench.
3. Check cable color coding with applicable engineer's specifications and National Electrical Code standards.

B. Electrical Tests

1. Perform insulation-resistance test on each feeder on the riser diagram with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for 1 minute.
2. Perform continuity test to insure proper cable connection.

C. Test Values

1. Evaluate results by comparison with cables of same length and type. Investigate any values less than 50 megohms.

3.07 GROUND-FAULT SYSTEMS (NEC 230-95)

A. Visual and Mechanical Inspection
   1. Inspect for physical damage and compliance with drawings and specifications.
   2. Inspect neutral main bonding connection to assure:
      a. Zero-sequence sensing system is grounded.
      b. Ground-strap sensing systems are grounded through sensing device.
      c. Ground connection is made ahead of neutral disconnect link on zero-sequence sensing systems.
      d. Grounded conductor (neutral) is solidly grounded.
   3. Inspect control power transformer to ensure adequate capacity for system.
   4. Manually operate monitor panels (if present) for:
      a. Trip test
      b. No trip test
      c. Nonautomatic reset
   5. Record proper operation and test sequence.
   6. Set pickup and time-delay settings in accordance with the settings provided.

B. Electrical Tests
   1. Measure system neutral insulation to ensure no shunt ground paths exist. Remove neutral-ground disconnect link. Measure neutral insulation resistance and replace link.
   2. Determine the relay pickup current by current injection at the sensor and operate the circuit interrupting device.
   3. Test the relay timing by injecting three hundred percent (300%) of pickup current, or as specified by manufacturer.
   4. Test the system operation at fifty-seven percent (57%) rated control voltage, if applicable.
   5. Test zone interlock systems by simultaneous sensor current injection and monitoring zone blocking function.
   6. On multiple source, tie breaker, etc., systems, devise a simulation scheme that fully proves correct operation.

C. Test Parameters
   1. System neutral insulation shall be a minimum of one hundred (100) ohms, preferably one (1) megohm or greater.
   2. Relay timing shall be in accordance with manufacturer's published time-current characteristic curves but in no case longer than one (1) second for fault currents equal to or greater than 3,000 amperes.
   3. Relay pickup value shall be within +/- 10% of setting and in no case greater than 1200A.

END OF SECTION

SECTION 26 20 00

LOW VOLTAGE ELECTRICAL DISTRIBUTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Section includes:

1. Current Transformer Cabinets
2. Automatic Circuit Breakers
3. Elevator Main Line Disconnects
4. Surge Protective Devices
5. Submetering & Data Collection System
6. Disconnect Switches
7. Contactors
8. Time Clock
9. Panelboards
10. Generator Docking Stations

B. Related Sections:

1. Section “Underground Ducts and Raceways For Electrical Systems” for coordination with connecting buried conduits, manholes, etc.
2. Section “Lightning Protection For Structures” for bonding and interconnection of electric service equipment.
3. Section “Common Work Results for Electrical” for concrete pads, bollards, labeling, and other general requirements.
4. Section “Grounding & Bonding for Electrical Systems” for grounding and bonding requirements.
5. Section “Low Voltage Power Conductors and Cables” for 600V conductors.
6. Section “Commissioning of Electrical Systems” for specific commissioning and functional performance testing requirements.

1.3 SUBMITTALS

A. Submittal Requirements of this section:

1. Current Transformer Cabinets
2. Automatic Circuit Breakers & Enclosures
3. Elevator Main Line Disconnects
4. Surge Protective Devices
5. Submetering & Data Collection system
6. Emergency Shutoff Switches
7. Pushbutton operators.
8. Disconnect Switches
9. Contactors
10. Time Clocks

11. Panelboards
12. Generator Docking Stations

B. Product data: Include dimensions, construction, materials, performance data, etc.

C. Provide submittal data for each product type.

1. To verify specifications have been met/exceeded.
2. Independent laboratory test data where requested.
3. Clearly indicate or state all options, etc.:

D. Submit the following for each Surge Protective Device:

1. Manufacturer/cat. number.
2. UL Listed and labeled per UL 1449 4th Edition and UL 1283.
3. Designation Type of the SPD and Type 1 Device Listing
4. Indicate surface or integral panel/switchboard mounting.
5. System voltage & configuration.
6. Short Circuit Current Rating (SCCR)
7. Voltage Protection Ratings (VPRs) for all modes
8. Maximum Continuous Operating Voltage rating (MCOV)
9. I-nominal rating (I-n)
10. Indicate options and/or accessories.
11. Suppression circuit design and components.
12. Proof of manufacturer’s 5-year warranty.
13. Manufacturer’s installation instruction manual.
14. Manufacturer’s recommended wire and breaker sizes clearly identified and marked.
15. Clearly identify manufacturer’s required external OCP breaker or fuse ratings.
16. Additional information to show compliance with specifications or drawings.
17. Shop drawings including and 1-line drawings detailing dimensions and weight of enclosure, internal wiring diagram illustrating all modes of protection in each type of SPD required, wiring diagram showing all field connections.

E. Submit the following for each panelboard:

1. Manufacturer/cat. number.
2. Surface or flush mounting.
3. Main lugs or breaker ratings.
4. Integral surge protection devices (SPD).
5. Special lug configurations (double main lugs, feed through lugs, etc.).
6. Non-linear ratings, oversized neutrals, etc.
7. Specific listing of all installed breakers, spares and spaces, including installed position within panel or switchboard.
8. Interrupting rating of components and assemblies.
9. Bus materials and ratings.
10. Additional information to show compliance with specifications or drawings.

F. Product Test Reports: Certified copies of manufacturer's design and routine factory tests required by the referenced standards.

G. Closeout Submittals: Submit in accordance with the General Conditions and Division 01 requirements, Section “Common Work Results For Electrical”, and as follows:

1. All post-installation inspection checklists.
2. Installer's pre-startup checklist.
3. Post installation load test results.
4. Preventative maintenance schedule for each unit.

1.4 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
3. Where equipment consists of multiple components, the entire assembly or product shall be UL Listed and Labeled or Labeled by a testing organization acceptable to the Authority Having Jurisdiction per the NEC.

B. Single-Source Responsibility:

1. The complete performance of assembled panelboards and/or switchboards, including all integral accessories, shall be the sole responsibility of the equipment supplier. It is the installer's responsibility to ensure that all factory and field installed accessories and loose components used in the system, meet these specifications, and perform up to the stated and tested standards.

C. Manufacturer/Vendor Requirements:

1. Coordinate the components of the system and their arrangements electrically and mechanically.
2. Manufacturer shall be experienced in manufacturing equipment of the types and capacities indicated that have a record of successful in-service performance for a minimum of 10 years.
3. Maintain, within 50 miles from site, a maintenance and service organization complete with parts inventory and repair facility. Service shall be available on a 24-hour basis.
4. Start-up services and post installation tests, as specified.

D. Installation Quality: In accordance with recognized trade organizations and standards.

1.	ANSI	American National Standards Institute
2.	ASME	American Society of Mechanical Engineers
3.	ASTM	American Society for Testing and Materials
4.	IEEE	Institute of Electrical and Electronics Engineers
5.	IEEE C2	National Electrical Safety Code
6.	NEC	National Electrical Code
7.	NECA	National Electrical Contractors' Association "*Standards of Installation*"
8.	NEMA	National Equipment Manufacturers Association
9.	NETA	National Electrical Testing Association
10.	NFPA	National Fire Protection Association
11.	UL	Underwriter's Laboratories

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Provide all transportation of equipment to site.
2. Provide for rigging needed for unloading and setting large panels or switchboards into final position.

B. Storage and Protection:

1. Where unit is to be installed indoors, without enclosure, store in covered building or offsite to prevent exposure to weather, etc.
2. Apply temporary heat according to manufacturer's recommendations within enclosure of each switchgear or switchboard section throughout periods during which equipment is not energized and is not under normal control of temperature and humidity.

1.6 PROJECT CONDITIONS

A. Electrical service to the facility:

1. 480Y/277 volt.
2. 3 phase, 4 wire.
3. Grounded wye.

1.7 SEQUENCING

A. General Sequencing:

1. Coordinate panelboard installation with exterior and/or interior construction.
2. Provide for sub-grade or subslab roughins.
3. Provide positioning and roughins such that required clearances are maintained after final installation.

1.8 WARRANTY

A. Special Warranty: Extended product warranties over and above that required by General Conditions of this contract.

1. Warranty shall be by the product manufacturer(s), as identified in each product specification.
2. Warranty includes all parts, labor, travel expenses, with no deductibles.
3. Installer/contractor shall complete and file all necessary documents with manufacturer, etc. to assure fulfillment of warranty requirements.
4. Deliver all extended warranty documents to Owner in O & M manuals with each product.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Available Manufacturers: Subject to compliance with requirements, provide a system by the named "Basis of Design" manufacturer, or a comparable product of one of the other following named manufacturers:

1. C/T Cabinets:
   a. Approved for use by BGE for use on BGE systems.
   b. Hoffman Enclosures
   c. S.A.R. Sheetmetals
   d. Meter Devices, Inc.
   e. Atlantic Sheet Metal
   f. Square D
2. Automatic Circuit Breakers & Enclosures:
   a. Square D/Schneider Electric (basis of design)
   b. ABB (GE)
   c. Eaton - Cutler-Hammer
3. Elevator Main Line Disconnects:
   a. Square D/Schneider Electric (basis of design)
   b. ABB (GE)
   c. Eaton - Cutler-Hammer
   d. Bussman
4. Surge Protective Devices:
   a. Square D/Schneider Electric (basis of design)
   b. ABB (GE)
   c. Eaton - Cutler-Hammer
   d. Advanced Protection Technologies, Inc.
   e. Surge Supression, Inc.
   f. Liebert
5. Submeters:
   a. Leviton Manufacturing Co., Inc. (basis of design)
   b. Osaki
   c. TigerTec Electronics, Inc.
6. Submetering & Data Collection System
   a. Leviton/Tehama Wireless (basis of design)
7. Safety Disconnect Switches:
   a. Square D/Schneider Electric (basis of design)
   b. ABB (GE)
   c. Eaton - Cutler-Hammer
   d. Menekes
8. Contactors:
   a. Square D/Schneider Electric (basis of design)
   b. ABB (GE)
   c. Cutler-Hammer
9. Time Clocks:
   a. Intermatic (basis of design)
   b. Tork
   c. Paragon
10. Panelboards:
    a. Square D/Schneider Electric (basis of design)
    b. ABB (GE)
    c. Eaton - Cutler-Hammer
11. Generator Docking Station
    a. Trystar, Inc. (basis of design)
    b. Power Temp Systems, Inc.
    c. Square D/Schneider Electric
    d. ABB (GE)
    e. Eaton - Cutler-Hammer

2.2 CURRENT TRANSFORMER CABINETS

A. Current transformer (C/T) cabinet for power company's metering equipment.

1. NEMA 3R cabinet.
2. UL Listed, Labeled "For Use on BGE Systems".
3. Welded Aluminum Construction.
4. Hinged doors with sealing studs.
5. Approved for use, and in accordance with BGE standards.
6. Rated 300 through 3000 amps of load.
7. 3-sided trough below for incoming conductors.

2.3 AUTOMATIC CIRCUIT BREAKERS

A. UL Listed, automatic circuit breakers for installation within panelboards and switchboards, or with enclosed cabinets and trim.

B. Circuit breakers:

1. Molded case, thermal magnetic, inverse time, unless noted otherwise.
2. Adjustable magnetic trip settings for thermal-magnetic breakers $\geq$225 amps.
3. Ratings as per drawings.
4. Accessories, as noted.
   a. Mechanical kirk key interlocking.
   b. Under-voltage trip.
5. Arc Flash Energy-Reduction Maintenance Switch: Per NEC 240.87, provide a manual switch that changes the trip settings on any adjustable trip breaker (with available trip settings of 1200A or higher) so as to minimize arc flash energy to downstream devices when active by lowering the instantaneous trip to the lowest possible setting. Provide with visual status indicator light on the breaker that indicates breaker is in Maintenance Mode.
6. Solid state electronic trip units for ground fault, long time pick-up and delay, short time pick-up and delay and instantaneous settings, where indicated. All breakers identified on drawings, or specified herein as having Electronic Trip Units (ETU) shall have the following features:
   a. Long Time Pickup and Delay.
   b. Short Time Pickup and Delay.
   c. Instantaneous.
   d. Ground Fault Pickup & Delay.
   e. Zone Selective Interlocking on Short Time and Ground Fault.
   f. True RMS sensing.
   g. Adjustable setpoints via clearly marked dials.
   h. Clear lexan cover to seal adjustable settings from tampering or accidental contact.
   i. Square D MicroLogic 6.0 Electronic Trip Units or product of comparable named manufacturer.
7. UL Listed Service Entrance use, where required.
8. Square D or comparable product from named manufacturers.
9. Where distribution system breakers have zone interlocking for selective coordination, all interlocked breakers shall be by the same manufacturer to insure proper communication and operation of the zone selective interlocking feature. This shall include the following breakers and locations, as applicable.
   a. Service entrance breakers.
   b. Distribution panelboard main and/or feeder breakers.
   c. Docking station breakers.

d. Generator main output breaker(s).

C. Ground Fault Circuit Interrupter (GFCI) branch breakers:

1. Installed in branch circuit panelboards and loadcenters where indicated.
2. Single or two pole, per panel schedule.
3. Class A protection, 6 mA trip for receptacle circuits.
4. Equipment ground fault protection, 30mA trip for heat trace or other non-receptacle circuits.

D. Enclosure and trim:

1. NEMA 1 enclosure, unless noted otherwise.
2. Deadfront cover.
3. Padlock provisions for locking breaker handle in ON or OFF position.
4. Rust-inhibiting phosphatized primer.
5. Factory finish paint (ANSI 61 gray).

2.4 ELEVATOR MAIN LINE DISCONNECTS

A. UL Listed, automatic circuit breakers or fusible disconnect switches for installation within elevator machine rooms, with enclosed cabinets and trim, serving as main line disconnect for elevator(s).

B. General:

1. UL Listed, dead-front device, providing overcurrent and short circuit protection of elevator motor.
2. Meets all requirements of NEC Article 620.
3. ANSI/ASME compliant for elevator main line disconnects.
4. Handle pad-lockable only in the "OFF" position.
5. Form C Auxiliary contacts (minimum of 2) to operate with main contacts (open when device is OFF). (Used for operation of battery lowering systems).
6. Provide relay for shunt trip voltage monitoring.

C. Fusible Elevator Control & Disconnect Switch:

1. Fusible Switch, heavy duty, 600V.
2. Dual Element, Class J fuses. Ratings as per drawings.
3. NEMA 4 or 12 enclosure with externally operable handle.
4. Handle lockable in OFF position.
5. 120 VAC shunt trip for operation via fire alarm relay (heat detector activated).
6. Keyed Test switch to operate the shunt trip mechanism.
7. Integral fused control power transformer (120VAC secondary for shunt trip coil operation).
8. Integral relay for monitoring status of 120VAC control power, per NFPA, by the fire alarm system. Relay shall change state upon loss of control voltage power, and not when switch is manually turned OFF.
9. Form C auxiliary contacts, mechanically interlocked with main disconnect switch, for interface with hydraulic elevator battery lowering system.
10. Cooper Bussman *Power Module Switches*, Eaton *Elevator Control ES Switch,* or comparable product from named manufacturers.

2.5 SURGE PROTECTIVE DEVICES

A. Minimum Design Standards, latest editions:

1. UL 1449. Latest Edition, “Surge Protective Devices”
2. UL 1283, “Standard for Electromagnetic Interference Filters Listed.”
3. ANSI/IEEE C62.33, “Standard Test Specifications for Varistor Surge-Protective Devices.”
4. ANSI/IEEE C62.41.1 – 2002, “IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits” and C62.41.2 – 2002, “IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.”
5. ANSI/IEEE C62.45 - 2002, “IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.”
6. ANSI/NFPA 70, “National Electrical Code Article 242.”

B. Surge Protection:
1. SPD shall provide surge current paths for all modes of protection:
   a. Wye systems: 10-modes; L-L, L-N, L-G, and N-G
2. Minimum surge current capability (single pulse rated) per phase shall be:
   a. Distribution Panels 160,000 A per phase
   b. Branch Panels 100,000 A per phase
3. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

System Voltage	L-N	L-G	L-L	N-G
208Y/120	700V	700V	1200V	700V
480Y/277	1200V	1200V	1800V	1200V

4. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V
480Y/277	15%	320V

5. SPD shall be UL labeled with 200kA Short Circuit Current Rating (SCCR). Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD, per NEC 242.10.
6. SPD shall be UL labeled as Type 2 (intended for use withexternal or supplemental overcurrent controls). Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal over-temperature controls. SPDs relying upon external or supplementary installed safety disconnects do not meet the intent of this specification.
7. SPD shall be UL labeled with 20kA I-nominal (I-n) for compliance to UL 96A Lightning Protection Master Label and NFPA 780.
8. SPD’s in main service switchboards or panelboards shall include a serviceable, replaceable modules (excludes Branch and Distribution Panel SPD’s).
9. Type 1 SPD’s shall also meet UL800 for use on line side of main disconnect.

C. EMI/RFI Filtering:

1. SPD shall have UL 1283 EMI/RFI filtering with minimum attenuation of -50dB at 100kHz.
2. Protection for common and normal mode noise.

D. Construction:

1. Stand-alone or integral panelboard/switchboard mounting, per drawings.
2. Separate enclosure mounting:
   a. Finished areas: Flush NEMA 1 steel enclosure, removable screw cover.

b. Unfinished areas: Surface mounted NEMA 1 steel enclosure, piano hinged cover.
c. Exterior installations: NEMA 4 gasketed housing, or SPD panel installed in NEMA 4 outer housing.
d. Integral main fused disconnect switch, service entrance rated.

3. Integral with panelboard/switchboard:
   a. NEMA 1, dead-front installation within the steel enclosure of panel or switchboard.
4. SPD shall be provided with integral disconnect switch when 3-pole breaker is not available for connecting the suppressor

E. Internal connections:

1. Connected in parallel with wiring system.
2. All internal wiring subject to surge currents shall utilize low-impedance copper bus bar and/or minimum #4 AWG copper conductors.
3. Compression solderless-type lugs bolted to bus bars.
4. No quick-disconnect terminals or PC boards permitted in surge current-carrying paths.
5. Externally visible status LED's (Green – OK, Red-Service), 1 pair per phase.
6. Audible alarm sounder for module failure.
7. Test/silence switch for LED’s/audible alarm.
8. 1 set of NO/NC dry contacts (Service Entrance switchboard or service entrance panelboard applications only)
9. Surge event counter with backup power source or EPROM memory to prevent loss of data (Service Entrance switchboard or service entrance panelboard applications only)

F. Manufacturer’s Warranty:

1. Ten (10) year unlimited module or unit replacement from initial start-up.
2. Warranty includes all parts, labor, travel expenses, with no deductibles.

G. Manufacturer:

1. Basis of Design is the following Square D models or comparable product by previously named manufacturers:
   a. Service Entrance: *Surgelogic* EMA Series
   b. Distribution Panels: *Surgelogic* EMA Series
   c. Branch Panels: *Surgelogic* EBA Series

2.6 SUBMETERS

A. Fully electronic, digital kilowatt-hour and demand meters for submetering.

1. Submeter shall record energy consumption (kw-hrs).
2. Peak demand (kw) display, with peak reset.
3. LCD display.
4. NEMA 1 steel enclosure
5. Rated for use on 277/480 or 120/208V, 3φ, 4W systems, or as indicated
6. Amp rating, to match application
7. 3P-15A circuit breaker voltage source connection to panelboard.
8. Solid or split core CT's with ratio to match submeter rating.
9. Capable of paralleling up to 3 CT's per phase for cumulative metering (provide

multiple CT's with identical ratios, per manufacturer).
10. UL 916 Listed meters and CT's.
11. ANSI C12.1 & C12.20 at 0.5% Accuracy Class.
12. Isolated pulse output.
13. Meter data capable of use for energy monitoring and tenant billing applications.
14. Non-volatile memory with no loss of metering data upon power loss.
15. 10 year warranty.
16. Leviton VerifEye Metering System, or comparable product by other named manufacturers.

2.1 SUBMETERING SYSTEMS

A. Provide fully electronic, digital kilowatt-hour data collection system, including CT's, submeters, equipment cabinets, pulse-modules, data hubs, all interconnecting cabling, and wireless communication equipment for submetering data collection system. Provide energy data collection and monitoring software.

B. Standards:

1. All meters, software and equipment of this section shall comply with the following applicable portions of the latest revisions of the following standards:
   a. ANSI C12.1 & C12.20 at 0.5% Accuracy Class
   b. UL Certified to IEC/EN/UL/CSA 61010-1 2nd Edition.
   c. UL 916 Listed meters and CT's.

C. Current Transformers:

1. 0.5% accuracy class 0.1A secondary solid core CT's that conform to applicable ANSI requirements or 1.0% accuracy split core CT's.
2. Solid or split core current transformers with full scale output of 0.1A.
3. Split core current transformers available from 100-5,000A
4. Current transformer secondary wiring can be extended up to 300 feet.

D. Meters:

1. Rated for use on 277/480V or 120/208V/3φ/4W systems, or as indicated.
2. Amp rating, to match applications.
3. Meters shall be mounted in one or more multi-meter cabinet enclosures.
4. Meters to be complete with a Liquid Crystal Display (LCD) to access energy measurements and phase diagnostics when needed
5. Meter data capable of use for energy monitoring and tenant billing applications.
6. Isolated pulse output.
7. Non-volatile memory with no loss of metering data upon power loss.
8. Energy Parameters:
   a. kWh real consumption
   b. kW instantaneous consumption
   c. kVAh apparent consumption
   d. kVA apparent power
   e. kVARh reactive consumption
   f. kVAR reactive power
9. Phase Diagnostics: Parameters to be displayed for each individual phase of each metered load:
   a. Voltage Phase to neutral or phase to phase
   b. Amps Instantaneous amperage for each phase

c.	kW	Instantaneous real energy
d.	PF	Power factor
e.	PA	Phase angle
f.	kVA	Instantaneous apparent energy
g.	KVAR	Instantaneous reactive energy

E. Data Collection And Communication:

1. Energy Monitor Hub:
   a. 120VAC input via Class 2 plug-in power supply transformer.
   b. NEMA 4 enclosure.

F. Warranty: 10 year manufacturer warranty.

G. Collection and Monitoring Software

1. Provide a web hosted software platform which is fully functional without software other than standard web browsers including, but not limited to, Microsoft Internet Explorer and Mozilla Firefox.
2. Software shall be used for the collection, analysis, and reporting of energy data from sub-metering equipment used to capture measurements from electrical utility.
3. Software shall collect and report data in intervals from one (1) to sixty (60) minutes and illustrate information in real time.
4. Software shall produce customized reports and display data for all energy management components including cost, kW, kVA, kVAR, and power factor
5. Software shall include an automatic reporting system and instant alarm notification system.
6. Enterprise Energy Management Software: Leviton Energy Manager.
7. Software shall be completely free to owner, without setup, use, application, or yearly maintenance or license fees.
8. Building Management Software; Leviton BMO 2.0 or comparable product from named manufacturers.

2.2 ELEVATOR SHUNT TRIP TEST BUTTONS

A. Shunt trip test pushbutton stations for testing operation of shunt trip breakers serving elevator feeders. Provide one test button for each shunt trip breaker.

1. Pushbutton operators, contact blocks, & mounting base.
2. Rated 120V, momentary contacts.
3. Recessed mounting in finished areas.
4. 1" diameter, black pushbutton with metal ring guard.
5. Contact blocks with (1) N.O. and (1) N.C. rated 10 Amps.
6. Square D, or comparable product from named manufacturers.

2.3 SAFETY DISCONNECT SWITCHES

A. Provide safety disconnect switches as shown on the drawings and where required by the National Electrical Code.

1. Horsepower rated for motor applications.
2. Solid neutral terminals where applicable.
3. Shielded phase conductor terminals.

4. Heavy duty type; 200kA Interrupting rating.
5. General duty type; 100kA Interrupting rating.
   a. NEMA 1 for interior.
   b. NEMA 3R for exterior, damp, or wet locations, on roof or on grade.
6. Cover interlock to prevent operation with cover open.
7. Rejection feature (Class R) fuses, for fused units.
8. Externally operated, with all current carrying parts silver or tin plated. Side handle, quick-make, quick-break operation.
9. Pad-lockable, minimum of 2.
10. Square D, or comparable product by previously named manufacturers.

2.4 LIGHTING CONTACTORS

A. UL listed for tungsten, fluorescent and/or HID ballast lighting application, 600 VAC.

1. Electrically operated, electrically held.
2. 120V control power transformer with prim/sec fusing.
3. 120 volt coil, controlled as indicated.
4. Number of poles per drawings.
5. Minimum 30 Amp rating without derating for load.
6. Enclosure: NEMA 1 for dry, indoor areas; NEMA 3R for damp, wet or exterior locations.
7. HOA switch installed on enclosure door.
8. Square D, or comparable product by previously named manufacturers.

2.5 TIME CLOCK

A. For lighting contactor control, etc.

B. Features:

1. Electronic, programmable, 120V input
2. 7-day scheduling (separate schedules per day).
3. Skip a day program capable.
4. DPST contacts rated 30 amps each, 120/277 VAC.
5. Manual On/Off/Automatic override control.
6. Integral battery backup to maintain programming for 3 years, minimum.
7. NEMA 1, side hinged enclosure (for indoors), NEMA 3R (for outdoors).

C. Intermatic #ET2125C, or comparable product by Tork or Paragon.

2.6 PANELBOARDS

A. UL Listed, factory assembled, circuit breaker panelboards with cabinets and trim, branch breakers.

B. Enclosure and trim:

1. NEMA 1 enclosure unless noted otherwise.
2. Front-hinged door with lock.
   a. All panels keyed alike.
   b. Factory finish paint (ANSI 61 gray) on all surfaces.

   c. Rust-inhibiting phosphatized primer.

d. Provide minimum (2) keys per lock.
3. Galvanized back box.
4. Recessed or surface mounting as indicated.

C. Ratings:

1. Fully rated interrupting ratings as per schedules.
2. UL Listed for Service Entrance, where applicable.
   a. Provide neutral to ground bonding.
3. Amp ratings as per drawing schedules.

D. Construction:

1. Main lugs or breaker per drawing schedules.
2. Main breakers with additional line side lugs or termination lugs for connection of line side Type 1 SPD.

3. All phase, neutral and ground bus bars shall be copper.
4. Interior equipment ground bar bonded to enclosure. Fully sized per NEC and UL, with sufficient lugs to accommodate all incoming and outgoing equipment grounding conductors.
5. Panels shall accept plug-on and bolt-on branch breakers.
6. Plug-on branch breakers for ratings ≤60 Amps.
7. Bolt-on branch breakers, unless noted, for ratings > 60 Amps.
   a. Use of connecting links, bars, etc. not permitted.
8. Sequence (A-B-C) bussing.
9. Up to 84 poles in single width panel, as noted on drawings.
10. Provide double width panels, where indicated, to include.
    a. Separate back boxes and front cover for each section.
    b. Poles equally divided between sections.
11. Molded case, thermal magnetic branch and main breakers.
12. Arc Flash Energy-Reduction Maintenance Switch: Per NEC 240.87, provide a manual switch that changes the trip settings on any adjustable trip breaker (with available trip settings of 1200A or higher) so as to minimize arc flash energy to downstream devices when active by lowering the instantaneous trip to the lowest possible setting. Provide with visual status indicator light on the breaker that indicates breaker is in Maintenance Mode.

E. Spare Breakers and Spaces:

1. As indicated on panel schedules.

F. Accessories:

1. Typewritten directory on panel door interior.
2. Internal or external SPD protection, for panels indicated on drawing riser diagram.

G. Combination Dispenser Circuit Manager / Panelboard – In addition to typical panelboard components, dispenser circuit manager shall include the following, all mounted in a single enclosure:

1. Functionality for power & low voltage emergency shutoff & maintenance disconnecting means of dispenser & pumps as indicated by drawings. Neutral

wires shall also be disconnected.

2. Locking cabinet doors meets OSHA Lock-out / Tag-out safety requirements.
3. Pre-wired control screens shall have a UL 508 Industrial Control Panel Listing.
4. Complete system shall have a UL 891 Deadfront Switchboard Listing as a complete assembly.
5. The entire system shall be factory tested, which includes 100% continuity, dielectric, and functional testing.
6. Two sets of full electrical and mechanical shop / installation drawings and component spec sheets included.
7. Factory installed fueling controls: Fueling controls for 9 dispensers / 4 turbine pumps. Provides complete emergency shutdown system for all dispensers and turbine pumps. Provides individual dispenser shutdown systems for both maintenance and multi-phase isolation. Includes contactors for all specified turbine pumps
   a. (9) DM-EX Modules provide MPD Control Signal Isolation
   b. (1) Emergency Fuel Shutdown Interface Terminal Strip
   c. (1) Tank Monitoring Equipment Interface Terminal Strip
   d. (1) Fuel Shutdown and Green Illuminated Reset switches flush mounted in cabinet door
   e. (4) Turbine pump pilot lights flush mounted in cabinet door
   f. (1) Miscellaneous Items and Labor
   g. All applicable controls will be factory wired and tested prior to shipment. Contractor will terminate MPD Control Signals directly to DM-EX Modules.
8. Factory installed turbine pump controls:
   a. (4) Turbine Pump 3-pole Contactors wired through Emergency Stop Controls.
   b. All applicable controls will be factory wired and tested prior to shipment. Line side of contactors will be factory wired to specified circuit breakers. Load side of contactors will be field wired directly to contactor lugs.
9. Factory installed low voltage disconnect controls: Single point of disconnect for Power AND Low Voltage when installed with DMEX Dispenser Manger Solutions from Square D IPaCS.
   a. Individual Dispenser Disconnect means for all required low voltage/control wiring.
   b. All applicable controls will be factory wired and tested prior to shipment. Line side of contactors will be factory wired to specified circuit breakers. Load side of contactors will be field wired directly to contactor lugs.
10. Cabinet Extension Kit (shipped loose) – Enclosure to extend to floor, match main enclosure size. #EE427CC.
11. Fuel system emergency stop switches (shipped loose):
    a. Remote mounted.
    b. Quantity per drawings.
    c. Switch enclosure 4”W x 6”H x 4”D, yellow, weather resistant, clear lift up cover
    d. Push, turn to reset pushbutton.
    e. Engraved labeling “EMERGENCY STOP”.
12. #EM04C.

H. Panelboard types (Square D models, or comparable product by previously named manufacturers):

1.	277/480V distribution (>600A)	I-Line
2.	277/480V distribution (≤600A)	NF

3. 277/480V branch circuit (≤600A) NF
4. 120/208V distribution (≤600A) NQ
5. 120/208V distribution (>600A) I-Line
6. 120/208V branch circuit (≤600A) NQ
7. 120/208V combination dispenser circuit manager/panelboard DCM-9D-4P-9L

2.7 DISTRIBUTION PANELBOARD (800 A THROUGH 1200 A)

A. Circuit breaker type distribution panelboard (drawings may indicate "switchboard") with circuit breaker branch circuit devices.

B. Enclosure and trim:

1. NEMA 1, dead front enclosure, unless noted otherwise.
2. Factory assembled frame and cover plates.
3. Front-hinged door(s) with lock.
   a. All panels keyed alike.
   b. Provide minimum (2) keys per lock.
4. Galvanized back box.
5. Factory finish painted front cover (ANSI 61 gray).
6. Recessed or surface mounting as indicated.

C. Ratings:

1. Fully rated interrupting ratings as per schedules.
2. UL Listed for Service Entrance, where applicable.
   a. Provide neutral to ground bonding.
3. Amp ratings as per drawing schedules.

D. Construction:

1. Main lugs or breaker per drawing schedules.
2. All phase, neutral and ground bus bars shall be copper.
3. Tin-plated bus at joints and connections.
4. Interior equipment ground bar bonded to enclosure.
5. 100% neutral bus.
6. Removable solid bar neutral link to permit disconnecting neutral bus from incoming neutral conductor on "Service Entrance" rated switchboards.
7. Plug-on bus connection breakers (I-Line).
   a. Use of connecting links, bars, etc. not permitted.
   b. Panel shall be capable of accepting branch breakers up to the frame size of the main lug or breaker rating.
8. Sequence (A-B-C) bussing.
9. Molded case, thermal magnetic branch and main breakers, unless noted otherwise.
10. Adjustable magnetic trip for all thermal-magnetic breakers ≥ 225 Amps.
11. Arc Flash Energy-Reduction Maintenance Switch on main and any feeder breakers rated ≥ 1200A.

E. Spare Breakers and Spaces:

1. As indicated on panel schedules.

F. Accessories:

1. Main Breaker with Ground Fault Protection.
2. Permanent ID plates for each breaker.

G. Square D I-Line, or comparable product by previously named manufacturers.

2.8 QUICK CONNECT EMERGENCY GENERATOR DOCKING STATION

A. Emergency Generator docking station to permit quick field connections of temporary rental generator to power life safety building load (ATS-1), when needed, and consisting of:

1. Quick-connect lugs section for temporary, removable generator feeder connections.
2. Breakers for incoming conductors of permanent and temporary generator connections.
3. Main output lugs for permanent conductor terminations.
4. Auto start terminals

B. Enclosure Construction and Features:

1. Outdoor, NEMA 3R, rain-tight, 304 GA aluminum enclosure.
2. Entire package must be listed to ETL or UL 1008 Standards
3. Roof, with overhanging drip edges, and anti-condensation treatment on underside.
4. Factory assembled frame and cover plates rigidly welded and bolted together.
5. Rust-inhibiting phosphatized primer.
6. Exterior grade, factory powder coat paint after fabrication finish (ANSI 49 gray), meeting all requirements of ANSI C57.12.28.
7. All hardware (including door fittings, fasteners, etc.), all operating-mechanism parts, and other parts subject to abrasive action from mechanical motion shall be of either nonferrous materials, or galvanized or zinc-nickel-plated materials.
8. Pad-lockable front door shall include a hinged access plate at the bottom for entry of cables from portable generator. NEMA 3R integrity shall be maintained with access plate open for cable entry.
9. Doors shall have a minimum of three high-strength latches.
10. Fully self-supporting, mounted on concrete slab, back to wall.

C. Ratings:

1. Integrated, fully rated short circuit interrupting ratings as per schedules.
2. System Ratings:
   a. 480/277 volt.
   b. 3 phase, 4 wire.
   c. Grounded wye.
3. Bus braced for minimum 65,000 amp withstand rating.
4. Amp ratings as per drawings.

D. Construction:

1. Phase and neutral bus bars shall be copper.
2. Plated bus.
3. Interior equipment ground bar bonded to enclosure.

4. 100% neutral bus.
5. Outgoing feeders through bottom of enclosure.
6. Lifting eyes.
7. Pad lockable.
8. Wall mount with factory installed external leg stands.

E. Incoming Generator Feeder Termination and Main Lugs Section:

1. Hinged front outer door, to allow access for terminating/removing temporary generator feeder conductors.
2. Designed to permit incoming generator conductors through bottom of panel. A hinged panel shall be provided to make connectors accessible. Generator feeders shall pass through access slots to reach connectors, but shall prevent accidental contact with energized components.
3. Outer Compartment door shall be capable of being locked closed after connecting incoming conductors.
4. Lockable rake system to prevent theft of installed/connected cables.
5. Generator conductor male camlock connectors with flip covers, color coded:
   a. 208/120V (Black, Red, Blue, White and Green).
6. Mechanical compression lugs for permanent outgoing wiring to ATS, concealed behind removable inner access panel. Lugs per phase to accommodate #4-1/0 copper conductors.
7. Fully rated main lugs and bus bars.
8. Factory installed phase rotation monitor.

F. Key Interlocked Docking Station Breakers:

1. UL Listed, automatic circuit breakers for manual switching of permanent and portable generator connections, and protection of downstream conductors and equipment.
2. Ratings as per drawings.
3. Mechanical kirk key interlocking (interlocked with permanent generator incoming feeder breaker within docking station) to prevent paralleling with portable generator.
4. Solid state electronic trip units for all breakers. Electronic Trip Units (ETU) shall have the following features:
   a. Long Time Pickup and Delay.
   b. Short Time Pickup and Delay.
   c. Instantaneous.
   d. Ground Fault Pickup & Delay.
   e. True RMS sensing.
   f. Adjustable set-points via clearly marked dials.
   g. Clear lexan cover to seal adjustable settings from tampering or accidental contact.
   h. Auxiliary contacts
   i. Square D MicroLogic 6.0 Electronic Trip Units, or approved equal.
5. Square D, or approved equal.

G. Trystar, Inc. Model DBDS-025L-LM-AS2, or comparable product by previously named manufacturers.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions: Examine the conditions under which the equipment shall be delivered, installed, and operated. Make all allowances required for operation, access and maintenance of the equipment, per Codes and manufacturers.

3.2 INSTALLATION

A. General Requirements:

1. Install all equipment, as indicated.
2. Maintain minimum working space at live parts according to manufacturer's written instructions and NEC.
3. Provide all required access space per NEC for controls, fuses and items requiring maintenance access.

B. Rough-in:

1. Roughin all underslab or below grade conduits, ducts, etc. prior to setting panels, switchboards or other equipment in place.
2. Coordinate exact stubups with proposed manufacturer's equipment installation drawings and the work of other trades in this contract.
3. Roughin for all required circuits, controls, connections, etc. as required by proposed equipment, even if not explicitly indicated on plans.
4. Make minor adjustments to locations so as to maintain required front working clearances and clearance above and below per NEC.

C. Current Transformer Cabinet Installation:

1. Comply with all requirements of the serving utility company.
2. Mount CT cabinet securely to building wall or other solid surface.
3. Train incoming conduits to enter below cabinet footprint, unless noted otherwise.
4. Provide meter socket directly above CT cabinet, with short conduit section between for utility wiring (minimum of 1-1/4").

D. SPD Panel Installation:

1. Comply with all requirements of NFPA 70, "National Electrical Code," and "Article 242," Surge Protection Devices."
2. Mount as close as practicable to protected panel or equipment.
3. Close nipple conduit connection to panel or switchboard, through vertical side.
4. Minimize conductor lengths (maximum of 12" lead lengths).
5. Coordinate location of breaker serving SPD.
   a. Mount breaker directly adjacent to SPD conduit/conductor entry.
6. Install conductors with few or no bends if possible.
   a. Utilize sweeping bends, where bending is required.
   b. Gently twist all conductors together between SPD and breaker.
7. Mount SPD unit adjacent to panel or switchboard at 6' AFF, if space permits. Mount directly above or below panel or switchboard if necessary.
8. Field connections:
   a. Full size for each phase, neutral and ground.
   b. #4 AWG for service entrance connections and distribution panel SPD applications.
   c. #8 AWG for Branch Circuit Panel SPD connections.

9. At Distribution and Branch panels, SPD shall have an independent means of servicing disconnect such that the protected panel remains energized. A 40A breaker (or larger) may serve this function.
10. Before energizing, installer shall verify service and separately derived system Neutral to Ground bonding jumpers are installed per NEC

E. Customer/Tenant Submeter Installation:

1. Comply with all requirements of NFPA 70, “National Electrical Code,” and manufacturer.
2. Mount meters, as indicated on plans, generally adjacent to metered equipment.
3. Label each submeter as to tenant, floor, and application.
4. Provide overcurrent protection for voltage sensing leads, connected to metered panel per manufacturer’s instructions.
5. Install CT’s in panelboard enclosure, per manufacturer’s instructions.
6. Install CT and voltage conductors from sensing location to meter location in EMT or flexible metal conduit.
7. Provide CT and voltage lead wiring type and size per manufacturer.
8. Do not install wiring from separate meters in common conduit.
9. Where submeter is connected to 2 or 3 sets of CT’s, in order to meter multiple source, provide engraved phenolic plate on meter face to indicate,
   METER CONNECTED TO # SOURCES
   MULTIPLY VALUE SHOWN BY #
10. Provide NEMA 1 enclosure(s), with removable front cover, above each source panelboard, for gathering and submetering of multiple branch circuits from panelboard below.
    a. One (1) CT enclosure for all “Lighting” branch circuits.
    b. One (1) CT enclosure for all “Outlets and Plug Load” branch circuits.
    c. One (1) CT enclosure for all “HVAC” branch circuits.
11. Mount enclosure directly above source panelboard, in electrical closet or above finished ceiling, as applicable.
12. Mount submeter CT’s in enclosure, following manufacturer’s instructions.
13. Route all branch circuits of each type to be metered through corresponding CT enclosure.
14. Within CT enclosure, separate all A-phase branch circuit conductors and route through A-phase CT. Do the same for B and C phase conductors, respectively.
15. Provide engraved phenolic plate on each CT enclosure to indicate,
    “LIGHTING BRANCH CKTS
    & METER CT’S”, or similar.

F. Panelboard Installation:

1. Comply with all requirements of NFPA 70, “National Electrical Code,” Article 110, “Requirements for Electrical Installations,” and Article 408, “Switchboards and Panelboards.”
2. Install panels with sufficient support from structure to prevent movement.
3. Arrange for blocking in stud walls, as required.
4. For multiple section panels, provide all nipples, conduit and conductors to continue the full feeder size between sections. For sections not installed side by side, provide extended feeder length, as required in rigid metallic raceway.
5. Install conduits for recessed panels 2" back from front edge of panel.
6. Provide recessed panelboards with 1" empty conduits installed from the panelboard top to accessible ceiling space as below:

TOTAL NUMBER OF SINGLE POLE SPARES AND SPACES	NUMBER OF 1" EMPTY CONDUITS
1 - 5	Two
6 - 10	Four
11 - 20	Five
More than 21	Ten

7. Balance loading on all panelboards as closely as possible and to the satisfaction of the Architect, after all branch circuits are connected and loads energized.
8. For dispenser circuit manager, provide all required power & low voltage wiring for emergency shutoff of dispensers & pumps, and maintenance disconnect of dispensers, as required by drawings.
9. Provide typed panelboard directories in each section to properly identify the circuits. Labeling shall include:
   a. Type of circuit: Lights, Outlets, etc.
   b. Room or rooms served, by room name or number.
   c. Special equipment: Fire alarm, copier, etc.

G. Circuit Breaker Installation:

1. Install circuit breakers in panelboards, or with enclosure, as required.
2. GFCI and AFCI circuit breakers: Provide circuits with dedicated neutral conductors. Connect neutral through breaker at panelboards, per manufacturer's instructions.
3. Provide labels on all protected outlet coverplates to indicate "GFCI PROTECTED" or "AFCI PROTECTED", as applicable.

H. Elevator Main Line Circuit Breaker Installation:

1. Comply with all requirements of ANSI/ASME 17.1, "Elevators and Escalators."
2. Provide elevator fused safety switch for each elevator in Elevator Machine Room.
3. Install on EMR wall on strike side of door, per State Elevator Code requirements.
4. Provide phenolic ID label to clearly indicate which elevator the breaker supplies. Label as "ELEVATOR DISCONNECT, ELEVATOR."
5. For shunt trip breakers, install shunt trip test button immediately adjacent to elevator breaker in Elevator Machine Room.
   a. Mounting height 48", directly adjacent to the elevator main line breaker.
6. Provide engraved red ID plate with white letters, at the shunt trip test button(s), to read: "ELEVATOR # SHUNT TRIP TEST"
7. Connect shunt trip wiring through fire alarm system relay or heat detectors, as indicated.
8. Provide all interconnecting wiring between pushbutton, fire alarm relay and shunt trip breaker.

I. Generator Docking Station Installation:

1. Comply with all requirements of NFPA 70, "National Electrical Code," Article 110, "Requirements for Electrical Installations," and Article 408, "Switchboards and Panelboards."
2. Mount assembly securely to wall, as shown.
3. Provide conc pad below units with support legs, as applicable.
4. Securely bolt frame legs to concrete pad.
5. Maintain 42" minimum clearance in front.

6. Provide engraved phenolic plastic nameplates to ID rotary switch and/or circuit breaker positions, as applicable.
7. Connect with ATS generator start circuit wiring and route thru docking station to allow auto start control of portable generator unit from ATS when connected.

J. Tamper Proof Hardware

1. Do not install any distribution or control equipment where accessible to prisoners.
2. Where equipment is located in areas which are accessible to prisoners,
   a. All equipment shall be lockable.
   b. Provide tamper proof hardware for all panels, switches etc. and any other equipment or items accessible to prisoners, as indicated on the drawings.

3.3 CONSTRUCTION

A. Interface with Other Work:

1. Provide connections between proposed distribution equipment and other work of this contract:
   a. Underground services and feeders.
   b. Automatic transfer switches.

B. Grounding: Ground switchboards, panelboards, all metallic service and distribution equipment frames and enclosures per NEC and as specified in Section “Grounding & Bonding For Electrical”.

C. Connections: Tighten joints, connectors and terminals, including screws and bolts, in accordance with manufacturer’s published torque tightening values for connectors and bolts. Where manufacturer’s torque requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A, “Wire Connectors and Soldering Lugs for Use with Copper Conductors.”

3.4 REPAIR/RESTORATION

A. Restore all finishes, equipment, surfaces and/or grade to original condition, where affected by the work of this section.

B. Comply with all requirements as specified in Section “Common Work Results For Electrical”.

3.5 FIELD QUALITY CONTROL

A. General:

1. Perform inspections and testing to ensure installation complies with Contract Documents, is operational within industry and manufacturer's tolerances, is adjusted to specific project parameters, and is suitable for energizing.
2. Acceptance Testing: Provide for acceptance testing of electrical equipment specified in this section, as follows, and as required in Section “Common Work Results for Electrical”.
3. Schedule tests and provide notification at least one week in advance of test commencement.
4. Provide a set of Contract Drawings to the testing agency.

5. Provide manufacturer's installation and testing instructions to the testing agency.
6. Provide complete shop drawing data on all equipment.
7. Provide written results of all tests. Include date, equipment ID, name of testing company and technician, and results of each individual test. Provide pass/fail indication for each test.

B. Pre-Testing Inspections:

1. Inspect accessible components for cleanliness, mechanical, and electrical integrity, for presence of damage or deterioration, and to ensure removal of temporary shipping bracing. Do not proceed with tests until deficiencies are corrected.
2. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, where not available, those of UL Standards 486A and 486B.
3. All settings, as specified in this section, shall be properly set and verified prior to equipment testing.

C. Acceptance Testing:

1. Panelboard Tests: After installing equipment, perform the following tests, at a minimum:
   a. Perform insulation resistance tests, phase-phase and phase-ground for all buses and main breaker(s).
   b. Perform continuity tests of all grounds, and bonded components.
   c. Perform tests to confirm proper bonding of neutrals to ground, where intended.
   d. Perform tests to confirm isolation of neutrals and grounds, except at intended locations.
   e. Perform overpotential tests per ANSI 37.20c.
   f. Operation of auxiliary contacts and devices.
   g. Operation of all gauges, displays and control equipment.

D. Ground Fault Sensors and Breakers:

1. Test entire GFP system including CT's, wiring, polarity, solid state device operation, and breaker or motor operated switch.
   a. Test using AC current injection method between each phase, neutral and ground.
   b. Verify proper operation including breaker trip for all possible ground fault conditions (i.e. Phase-Ground & Neutral-Ground).
   c. Verify that system does not nuisance trip with single phase (Phase-Neutral) loads, where applicable.
   d. Test each GFP system and breakers.

E. Test Failures: Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest. Remove and replace malfunctioning components with new, and retest.

F. Test Labeling: Upon satisfactory completion of tests for each transformer, attach a dated and signed "Satisfactory Test" label to the unit.

3.6 IDENTIFICATION

A. Identify all distribution system components and wiring in accordance with Section “Common Work Results For Electrical”.

1. Provide engraved nameplate for each individual switchboard, switchgear, panelboard, fusible switch, enclosed breaker, etc. , which identifies the equipment per project nomenclature.
2. Meter Stacks: Provide an engraved nameplate for each meter stack meter/main breaker identifying the apartment or dwelling unit served.

B. Provide permanent warning signs on all electrical switchgear, switchboards, on electrical room doors, and on fenced yards containing such equipment. Warning signs shall be as specified in section “Common Work Results for Electrical”.

3.7 ADJUSTING

A. General:

1. Set all field adjustable parameters to those as specified.
2. Set field adjustable pickup and time delay ranges of Ground Fault Systems and solid state breakers as indicated.

3.8 CLEANING

A. General:

1. Inspect interior and exterior of installed equipment and switchgear.
2. Remove paint splatters and other spots, dirt, and debris.
3. Touch up scratches and mars of finish to match original finish.
4. Remove protective films, etc. from all devices, controls, etc.
5. Remove debris, insulation and wire clippings, dirt, etc. from interior of all equipment.
6. Remove dirt, debris, etc. from top of all equipment.

3.9 DEMONSTRATION

A. Owner Demonstrations: Provide a factory trained representative for each system and type of equipment, for the purpose of training owner's personnel:

1. Discuss proper operation, maintenance, and use of all equipment.
2. Demonstrate periodic Owner testing and/or inspection of equipment.
3. Demonstrate adjustment to Owner-accessible equipment and systems.
4. Instructors shall be fully knowledgeable of the installed equipment and all components.
5. Training shall be completed at the project site following Owner occupancy, at Owner’s discretion.
6. Schedule after all final tests, adjustments and Owner's acceptance.
7. Training shall consist of a minimum of (4) hours of training and instruction, including use of delivered O&M manuals for each system or equipment.

3.10 COMMISSIONING

A. This project includes Commissioning of selected systems and components. Provide for commissioning of the low voltage distribution system(s), as required per Section “Commissioning of Electrical Systems”, and the Commissioning Plan.

END OF SECTION

SECTION 26 22 00

LOW VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Section Includes:

1. Low Voltage dry type transformers.

B. Related Sections:

1. Section “Common Work Results for Electrical” for concrete pads, labeling, and other general requirements.
2. Section “Grounding & Bonding for Electrical Systems” for grounding and bonding requirements.
3. Section “Low Voltage Power Conductors and Cables” for 600V conductors.
4. Section “Raceways and Boxes for Electrical Systems” for conduit and raceway connections.
5. Section “Commissioning of Electrical Systems” for specific commissioning and functional performance testing requirements.

1.3 SUBMITTALS

A. Submittal Requirements of this section:

1. Low Voltage dry type transformers.

B. Provide submittal data for each product type.

1. To verify specifications have been met/exceeded.
2. Independent laboratory test data where requested.
3. Clearly indicate or state all options, etc.

C. Submit the following for each dry type transformer:

1. Overall dimensions.
2. Weight.
3. Winding materials.
4. Insulation materials and Class.
5. Bus and lug materials.
6. Capacity rating.
7. Primary and secondary voltages and phases.
8. Winding configurations, delta, wye, etc.
9. Wiring diagrams.
10. Efficiency at full and part loads.

11. Total watts lost to space (BtuH).
12. Temperature rise rating.
13. Tap quantities and ratings.
14. Sound ratings.
15. Efficiency ratings, compliant with NEMA TP-1 and DOE 2016.
16. Enclosure and NEMA rating.
17. UL Listing.

D. Product Test Reports: Certified copies of manufacturer's design and routine factory tests required by the referenced standards.

1. Sound Level Test Reports: Certified copies of manufacturer's sound level tests applicable to equipment for this Project.

E. Closeout Submittals: Submit in accordance with the General Conditions and Division 01 requirements, Section “Common Work Results For Electrical”, and as follows:

1. All post-installation inspection checklists.
2. Post installation load test results.
3. Preventative maintenance and testing schedule for each unit.

1.4 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms “Listed and Labeled”: As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.

B. Manufacturer/Vendor Requirements:

1. Coordinate the components of the system and their arrangements electrically and mechanically.
2. Manufacturer shall be experienced in manufacturing equipment of the types and capacities indicated that have a record of successful in-service performance for a minimum of 10 years.
3. Maintain, within 50 miles from site, a maintenance and service organization complete with parts inventory and repair facility. Service shall be available on a 24-hour basis.
4. Start up services and post installation tests, as specified.

C. Installation Quality: In accordance with recognized trade organizations and standards.

1.	ANSI	American National Standards Institute
2.	ASME	American Society of Mechanical Engineers
3.	ASTM	American Society for Testing and Materials
4.	IEEE	Institute of Electrical and Electronics Engineers
5.	IEEE C2	National Electrical Safety Code
6.	NEC	National Electrical Code
7.	NECA	National Electrical Contractor’s Association “Standards of Installation.”
8.	NEMA	National Equipment Manufacturers Association

9. NESC National Electrical Safety Code
10. NETA National Electrical Testing Association
11. NFPA National Fire Protection Association
12. UL Underwriter's Laboratories

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Provide all transportation of unit(s) to site.
2. Provide for rigging needed for unloading, and setting into final position.

B. Storage and Protection:

1. Where unit is to be installed indoors, store in covered building or offsite to prevent exposure to weather, etc. until building is suitable for transformer installation.
2. Temporary Heating: Apply temporary heat according to manufacturer's recommendations within the enclosure of each ventilated type unit throughout periods during which equipment is not energized and is not in a space that is continuously under normal control of temperature and humidity.

1.6 SEQUENCING

A. General Sequencing:

1. Coordinate transformer installation with exterior and/or interior construction.
2. Provide for sub-grade or subslab roughins.
3. Coordinate construction of concrete pads with transformer locations.

B. Sequencing, Coordination, and Integration:

1. Provide positioning and unit roughin such that required clearances are maintained after final installation of all finishes, surface treatments, ceilings, ducts, etc.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Available Manufacturers: Subject to compliance with requirements, provide a system by the named "Basis of Design" manufacturer, or a comparable product of one of the other following named manufacturers:

1. Low Voltage Transformers:
   a. Square D/Schneider Electric (basis of design)
   b. ABB (GE).
   c. Siemens
   d. Cutler-Hammer
   e. Sola/Hevi-Duti
   f. Olsun Electrics Corp.
   g. Acme Electric Corp.

2.2 MATERIALS

A. General:

1. Comply with NEMA Standard ST 20, “Dry-Type Transformers for General Applications.”
2. Sound levels shall comply with NEMA Standard TR 1, “Transformers, Regulators, and Reactors” for dry type transformers.
3. Life expectancies as defined by ANSI/IEEE C57.96, “IEEE Guide for Loading Dry Type Distribution and Power Transformers.”
4. Design, manufacture and testing per ANSI, NEMA and IEEE.
5. Efficiency ratings shall meet or exceed:
   a. NEMA TP1
   b. Department of Energy – 10 CFR Part 431 - Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule (DOE 2016).

B. Finishes:

1. Indoor Units: Manufacturer's standard paint over corrosion-resistant pretreatment and primer.

C. Insulation:

1. Non-hygroscopic materials.
2. Self-extinguishing, non-flammable construction.

2.3 LOW VOLTAGE DRY TYPE TRANSFORMERS

A. Two-winding type, 3-phase units using 1 coil per phase in primary and secondary, unless noted otherwise on drawings.

B. General:

1. UL Listed, general purpose, 600 volt class.
2. 480 volt, 3 phase delta primary, unless noted.
3. 208/120 volts, 3 phase, grounded wye secondary, unless noted.
4. Self-cooled, two winding type with NEMA 2 drip proof enclosures.
5. Floor mounted, wall mounted, or suspended per drawings.
6. Internal rubber vibration isolation mounts to minimize noise.
7. Heavy gauge steel, primed and finished in ANSI 61 gray weather resistant enamel.
8. For all units not mounted directly on slab or concrete pad, provide a perforated metal bottom plate to prevent contact with exposed bus or lugs from below.
9. Efficiency ratings shall meet or exceed the requirements of NEMA TP-1.

C. Construction (3 kVA through 25 kVA):

1. Epoxy resin encapsulated.
2. Completely enclosed.
3. Class H insulation, 185°C rated for 115°C temperature rise over a 40°C ambient.
4. (4) 22% taps, two (2) taps FCAN and two (2) taps FCBN.

D. Construction (30 kVA and above):

1. Ventilated housing with epoxy laminated windings.
2. Class H insulation, 220°C rated for 150°C temperature rise over a 40°C ambient.
3. Temperature Rise:
   a. 150°C maximum rise above 40°C,
4. (6) 22% taps, two (2) taps FCAN and four (4) taps FCBN.
5. 30 kVA units and larger shall be constructed of self-extinguishing Class 1 materials.

E. Cores:

1. High grade, grain oriented silicon steel.
2. Low hysteresis and eddy current losses.

F. Coils:

1. Aluminum or copper windings.
2. Impregnated with cured, non-hygroscopic epoxy resin.
3. Brazed or pressure connection of windings.

2.4 SOURCE QUALITY CONTROL:

A. Tests & Inspections: Manufacturer shall provide inspections and tests of transformers, as required by referenced standards.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions: Examine the conditions under which the equipment shall be delivered, installed, and operated. Make all allowances required for operation, access and maintenance of the equipment, per Codes and manufacturers.

3.2 INSTALLATION

A. General Requirements:

1. Comply with all requirements of NFPA 70, National Electrical Code, Article 110 “Requirements for Electrical Installations,” and Article 450, “Transformers and Transformer Vaults.”
2. Install all equipment, as indicated.
3. Maintain minimum working space at live parts according to manufacturer’s written instructions and NEC.
4. Provide all required access space per NEC for controls, fuses and items requiring maintenance access.
5. Maintain all required clearances for cooling, per manufacturer, and as per NEC.

B. Rough-in:

1. Roughin all underslab or below grade conduits, prior to setting transformers in place.
2. Coordinate exact stubups with proposed manufacturer’s equipment installation drawings and the work of other trades in this contract.

C. Make minor adjustments to locations so as to maintain required front working clearances

and clearance above and below per NEC.

D. Floor Mounted Units:

1. Bolt to floor or concrete pad, with concrete anchors.
2. Rubber vibration isolation pads under mounting surfaces.
3. All wiring connections to use flexible metal conduit.
4. Mount a minimum of 6 inches from walls.

E. Suspended Units:

1. Support by four (4) threaded rods.
2. Provide steel angle or strut bridging, intermediate steel beams, etc. for suspension from structure above.
3. Where bridging is attached to steel joists, locate bridging perpendicular to joist and within 4 inches of the bottom of chord “V”’s.
4. Spring vibration isolators in each support rod within 12 inches of connection to structure.
5. Double nuts and lock washers at all bolted connections and support rods.
6. Support below unit with double steel strut or steel angle, washers and double nuts on threaded rods.
7. Provide diagonal sway bracing to prevent movement in two horizontal directions.
8. All wiring connections to use flexible metal conduit.
9. Mount a minimum of 24 inches from walls and ceiling or structure, where practicable. Twelve inches from combustibles are required for units 112.5 kVA and larger, per NEC.
10. Maintain minimum clear “working space” below transformer and supporting elements, per NEC Article 110.

3.3 CONSTRUCTION

A. Grounding: Ground transformers, all equipment frames and enclosures per NEC and as specified in Section “Grounding & Bonding For Electrical Systems.”

B. Connections: Tighten all connectors, terminals, lugs, etc. including screws and bolts, in accordance with manufacturer’s published torque tightening values for connectors and bolts. Where manufacturer’s torque requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A, “Wire Connectors and Soldering Lugs for Use with Copper Conductors” and 486B, “Wire Connectors for Use with Aluminum Conductors.”

3.4 REPAIR/RESTORATION

A. Restore all finishes, equipment, surfaces and/or grade to original condition, where affected by the work of this section.

B. Comply with all requirements as specified in Section “Common Work Results For Electrical.”

3.5 FIELD QUALITY CONTROL

A. General:

1. Perform inspections and testing to ensure installation complies with Contract

Documents, is operational within industry and manufacturer's tolerances, is adjusted to specific project parameters, and is suitable for energizing.

2. Acceptance Testing: Provide for acceptance testing of electrical equipment specified in this section, as follows, and as required in Section “Common Work For Electrical.”
3. Schedule tests and provide notification at least one week in advance of test commencement.
4. Provide a set of Contract Drawings to the testing agency, where applicable.
5. Provide manufacturer's installation and testing instructions to the testing agency, where applicable.
6. Provide complete shop drawing data on all equipment.
7. Provide written results of all tests. Include date, equipment ID, name of testing company and technician, and results of each individual test. Provide pass/fail indication for each test.

B. Pre-Testing Inspections:

1. Inspect accessible components for cleanliness, mechanical, and electrical integrity, for presence of damage or deterioration, and to ensure removal of temporary shipping bracing. Do not proceed with tests until deficiencies are corrected.
2. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, where not available, those of UL Standards 486A and 486B.

C. Acceptance Tests: Perform the following minimum tests according to the manufacturer's instructions and NETA recommendations. Conform to ANSI C57.12.91, “IEEE Standard Test Code for Dry-Type Distribution and Power Transformers” for dry-type units, test method, and data correction factors.

1. Ratio tests at rated voltage connection and all tap connections.
2. Polarity and phase-relation tests at rated voltage.
3. Applied potential tests.
4. Induced potential tests.

D. Test Failures: Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest. Remove and replace malfunctioning components with new, and retest.

E. Test Labeling: Upon satisfactory completion of tests for each transformer, attach a dated and signed "Satisfactory Test" label to the unit.

3.6 ADJUSTING

A. Adjust transformer taps to provide optimum (nominal) voltage conditions at utilization equipment throughout the normal operating cycle of the facility. Record voltages and tap settings to submit with test results.

3.7 CLEANING

A. General:

1. Inspect interior and exterior of installed transformers.
2. Remove paint splatters and other spots, dirt, and debris.

3. Touch up scratches and mars of finish to match original finish.
4. Remove labels, stickers, and protective films, etc. from all enclosures.
5. Remove debris, insulation and wire clippings, dirt, etc. from interior of all equipment.
6. Remove dirt, debris, etc. from top of all equipment.

B. Finish Touch Up: After completing installation, cleaning, and testing, touch up scratches and mars on finish to match original finish.

3.8 COMMISSIONING

A. This project includes Commissioning of selected systems and components. Provide for commissioning of the LV transformer(s), as required per Section “Commissioning of Electrical Systems”, and the Commissioning Plan.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Section Includes:

1. A/C switches.
2. Receptacles.
3. Connectors.
4. Device plates and covers.

B. Related Sections:

1. Section “Common Work Results for Electrical.”
2. Section “Low Voltage Electrical Power Conductors and Cables” for connecting wiring, cables and conductors.
3. Section “Raceways & Boxes for Electrical Systems” in which devices are to be installed.
4. Section “Lighting” for additional low voltage switches, occupancy sensor switches and dimming devices.

1.3 SUBMITTALS

A. Submittal Requirements of this section:

1. A/C switches.
2. Receptacles.
3. Connectors.
4. Device plates and covers.

B. Product data for each device type:

1. Manufacturer's specifications, data sheets.
2. Capacity ratings, NEMA configurations, etc.
3. Information required indicating contract compliance.
4. Device color.
5. UL Listing.

C. Closeout Submittals: Submit in accordance with the General Conditions and Division 01 requirements, and Section “Common Work Results For Electrical”.

1.4 QUALITY CONTROL

A. Product Coordination Responsibility

1. The contractor shall insure that all proposed control and/or dimmer switches are fully compatible and matched with the proposed light fixtures.
2. Contractor shall confirm compatibility of proposed controls/switches with proposed lighting fixtures prior to submitting for approval or ordering.

1.5 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection:

1. Deliver and store wiring devices and accessories according to manufacturers' instructions.
2. Do not store in unheated areas of high humidity, which might create corrosion or other deterioration.
3. Do not store in areas subject to high temperatures, which might cause deterioration or deformation of products.

1.6 SEQUENCING

A. General Sequencing:

1. Sequence installation of devices and equipment of this section such that damage to installed equipment is minimized.
2. Install device plates after all wall finishes have been completed.

B. Electrical Division Sequencing, Coordination, and Integration:

1. Provide installation of wiring devices after supporting raceways and boxes are permanently installed.
2. Provide coordination of proposed wiring devices with actual cord/plug requirements of attached equipment.
3. Match wiring devices to plug connectors for Owner-furnished equipment.
4. Match wiring devices to plug connectors for equipment furnished under other Divisions.
5. Do not install permanently wired flexible connectors and associated cables/service cords until attached equipment is in place.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Available Manufacturers: Subject to compliance with requirements, provide products by the named "Basis of Design" manufacturer, or a comparable product of one of the other following named manufacturers:

1. Switches & Receptacles:
   a. Eaton Arrow-Hart Cooper
   b. Hubbell
   c. Leviton
   d. Pass & Seymour

2.2 WIRING DEVICES - GENERAL

A. Comply with NEMA Standard WD 1, "General Purpose Wiring Devices"

B. Color: WHITE except as otherwise indicated or required by Code.

C. UL Listed.

D. All devices shall be of one manufacturer.

E. Prewired pigtail connectors that accommodate Fed Spec receptacles, GFCIs and switches are approved. Must be crimped and welded terminal right angle application within the connector.

F. All receptacles in dwelling units and any areas accessible to the public, including exterior locations, shall be of tamper resistant (TR) construction.

2.3 A/C SWITCHES

A. Toggle Switches:

1. Silent mechanical type rated 20 ampere, 120/277VAC.
2. Fed. Specification #WS896-E.
3. 1-piece Lexan cam and toggle.
4. 20 amp rating.
5. Single pole, 3-way or 4-way, per drawings.
6. Back and side wiring provisions.
7. Arrow-Hart #1991 Series.

2.4 RECEPTACLES

A. Receptacles:

1. Construction, spec-grade.
2. Duplex NEMA 5-20R, 120 volt, 20 amp, 3 wire, U-ground.
3. Federal Specification #WS596-F.
4. Lexan or nylon body, metal yokes.
5. Arrow Hart #5362.

B. Ground Fault Interrupting (GFI) Receptacles:

1. Class A, UL943 listed, feed-thru type.
2. Screw terminal connections.
3. GFCI Receptacles shall have SafeLock protection. If critical components are damaged and ground fault protection is lost or if mis-wired, power to receptacle is disconnected.
4. End-of-life provision shall render outlet incapable of delivering power upon failure of GFCI function.
5. Reverse Line Mis-wire: receptacle shall not provide power if the hot and neutral wires are reverse wired.
6. Arrow-Hart #VGF20.

C. Weather & Tamper Resistant Ground Fault Interrupting (WR-GFI-TR) Receptacles (for exterior use and interior damp/wet locations):

1. Class A, UL943 listed, feed-thru type.
2. 120VAC, 20 Amp rated. NEMA 5-20R

3. Screw terminal connections.
4. GFCI Receptacles shall have Safe-Lock protection. If critical components are damaged and ground fault protection is lost or if mis-wired, power to receptacle is disconnected.
5. End-of-life provision shall render outlet incapable of delivering power upon failure of GFCI function.
6. Reverse Line Mis-wire: receptacle shall not provide power if the hot and neutral wires are reverse wired.
7. UL Listed as “Tamper Resistant” and “Weather Resistant” with identifying “TWR” label.
8. Arrow-Hart #TWRSGF20, Leviton, Pass & Seymour, Hubbell, or equal.

D. Weather & Tamper Resistant Duplex Receptacle (TWR) (for exterior use and interior damp/wet locations):

1. Construction, spec-grade.
2. Duplex NEMA 5-20R, 120 volt, 20 amp, 3 wire, U-ground.
3. Federal Specification #WS596-G.
4. Lexan or nylon body, metal yokes.
5. UL Listed as “Tamper Resistant” and “Weather Resistant” with identifying “TWR” label.
6. Arrow Hart #TWRBR20.

E. Controlled Receptacles:

1. All outlets controlled by occupancy sensors, per IGCC Plug Load Control requirements, shall be marked, as required per NEC.
2. Each plug-position on face of all controlled outlets shall be labelled with “Controlled” and corresponding marking symbol, as applicable.
3. Dual or Half-controlled outlet construction, as required per drawings.
4. Tamper Resistant (TR) construction and labelled.
5. Arrow Hart TR5362-CD (dual), Arrow Hart TR5362-CH (half), or equal.

F. Special Receptacles:

1. NEMA configurations per drawings.
2. Specification grade.
3. Lexan or nylon body, metal yokes.
4. Locking or straight-blade configurations, per plans.
5. Leviton V-0-MAX.

2.5 SPECIALTY RECEPTACLES

A. Combination Tamper-Resistant Duplex Receptacle & USB Charger:

1. Duplex NEMA 5-20R, 120 volt, 20 amp, 3 wire, U-ground.
2. Commercial spec grade.
3. Tamper Resistant (TR) construction with dual spring-loaded shutters to block single object insertion into either H or N openings.
4. Dual 5VDC, USB charging ports, one USB-A and one USB-C ports.
5. Capable of charging two USB devices simultaneously.
6. Total of 5.0 Amps of charging capacity.
7. Decora style for mounting in single gang box.
8. Eaton Arrow-Hart TRUSBAC20* 7756* series.

2.6 CONNECTORS

A. Cord Receptacles & Connectors:

1. Spec grade, industrial duty, and impact resistant nylon construction.
2. High visibility yellow exterior.
3. Cord grip to prevent terminal strain.
4. Deep well wire terminals, captive brass screws.
5. Dead front, captive screws, NEMA configuration molded in.
6. Female: deep set, triple wipe brass contacts.
7. Males: Solid brass blades molded into body.
8. Leviton Industrial, or equal.

2.7 DEVICE PLATES & COVERS

A. Single and combination types that mate and match with corresponding wiring devices. Provide for every switch and outlet.

B. Interior Plate Finishes:

1. Finished Spaces: Stainless steel, satin-finish, type 302, 0.04” thick.
2. Unfinished Spaces: Galvanized steel.

C. Features include the following:

1. Plate-Securing Screws: Stainless steel, galvanized or colored, to match plate finish.
2. Arrow-Hart, Leviton, Pass & Seymour, or equal.

D. Weatherproof Covers:

1. Non-Metallic Damp & Wet Location Covers:
   a. Non-metallic, polycarbonate.
   b. Gasketed, self-closing.
   c. Clear, hinged lift lid.
   d. Weatherproof during operation per NEC
   e. Eagle WeatherBox, Pass & Seymour, or equal.

E. Security/Detention/Prison covers for prisoner cells and ~~inmate~~ accessible areas:

1. Plate-Securing Screws: Hardened stainless steel, tamper proof screws (torx-center pin).
2. Back plate: 10 gauge galvanized steel with offset corners.
3. Wiring device attaches directly to steel backplate (not to outer coverplate).
4. Cover plate: Die formed, 14 gauge CRS with tamperproof securing screws at each of four corners.
5. Switch cover plates shall have two vertical steel “fins” on each side of each toggle switch, to protect toggle mechanism from damage
6. Finish: 5-stage polyester or Urethane powder coat.
7. UL Listed.
8. Provide one matching torx center pin driver for every 100 covers installed.
9. Kenall Mighty Mac or New Star Lighting NSH series.

PART 3 EXECUTION

3.1 INSTALLATION

A. General Requirements:

1. Install all equipment plumb and level.
2. Install devices tight to boxes, etc. such that no movement occurs during normal connecting and disconnecting procedures or operation.
3. Install coverplates tight to surrounding surface. Coverplate shall not provide the only means of support for wiring devices.
4. Where multiple devices are installed at the same location and elevation, use a single, multi-gang box and single cover plate, as applicable.
5. Do not install receptacles directly behind any sinks, or within 36” of showers or bathtubs.
6. Where wiring devices, such as occupancy, dimmer, timer or other control switches, require a grounded conductor (neutral) connection for operation, install neutral conductor to the mounting box. Do not connect device neutral to equipment ground wire.
7. Where standard toggle switches are installed serving lighting loads in areas described in NEC 404.2(C), provide a grounded conductor (neutral) to the switch device box location as specified. Do not connect device neutral to equipment ground wire.

B. Rough-in: Unless noted otherwise, the following mounting heights shall be used:

1.	Wall receptacles:	18" AFF to center.
2.	Counter top receptacles:	6" above counter to bottom of box.
3.	Wall switches:	48" AFF to center.
4.	Exterior receptacles:	24" above grade.
5.	Roof receptacles:	24" above roof surface.
6.	Elevator Pits:	36” above bottom of pit.
7.	Full-size frig/freezer:	42" AFF to center.

C. Ceiling Mounted Outlets:

1. Install all ceiling mounted receptacles as follows:
   a. Flush mounted back box, with stainless steel coverplate installed tight to ceiling tile, plaster, or GWB ceiling.
   b. Support back box independently of ceiling, with rigid support from structure.
   c. Twistlock outlets, unless noted otherwise.

D. Identification:

1. Permanently identify all general-purpose and dedicated equipment receptacles in all spaces in accordance with the project nomenclature.
   a. At every receptacle, identify source panel and circuit number (i.e. RP1-12) via machine printed label (i.e. Brother P-Touch, or equal) applied at top of cover plate. Printing shall be black, minimum 1/4” high text. Label shall be visible with plug installed, as practicable.

E. Tamper Proof Hardware

1. Provide tamper proof hardware for all cover plates, device plates, outlets, switches, etc. installed under this Division where such equipment is accessible to prisoners ~~inmates~~ at any time. Such locations are indicated on the contract drawings.

3.2 REPAIR/RESTORATION

A. Restore all finishes, equipment and surfaces to original condition, where affected by the work of this section.

~~3.3 RE-INSTALLATION~~

~~A. Reinstall all outlets, coverplates and similar devices, where removed to accomplish the work of these documents.~~

~~B. Where the devices are damaged during removal or reinstallation, replace with new devices of similar quality, color, etc. to existing.~~

~~3.4~~3.3 CLEANING

A. General:

1. Clean all construction debris from within outlet boxes, prior to close up.
2. Remove all paint, joint compound and other marks from devices and coverplates.

END OF SECTION

SECTION 26 29 00

LOW VOLTAGE CONTROLLERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Section Includes:

1. Thermal manual motor starter switches.
2. General purpose relays.
3. Full voltage motor starters.

B. Related Sections:

1. Section “Common Motor Requirements” for coordination with motors furnished and/or installed as part of mechanical division.
2. Section “Variable Frequency Drives” for coordination with and installation requirements for VFD driven motors.
3. Section “Instrumentation And Control For HVAC” for interface and control requirements.
4. Section “Common Work Results for Electrical” for labeling, and other general requirements.
5. Section “Grounding & Bonding for Electrical Systems” for grounding and bonding requirements.
6. Section “Low Voltage Power Conductors and Cables” for 600V conductors.
7. Section “Raceways & Boxes For Electrical Systems” for required connections of motors.
8. Section “Commissioning of Electrical Systems” for specific commissioning and functional performance testing requirements.

C. Products Installed But Not Supplied Under This Section:

1. Variable frequency drives furnished under mechanical Section “Variable Frequency Drives”.
2. Speed control switches furnished under mechanical divisions for control of small motors, fans, etc.

1.3 REFERENCES

A. National Electrical Code:

1. NEC 430 Motors, Motor Circuits and Controllers

B. NEMA:

1. NEMA AB 1 Molded Case Circuit Breakers

2. NEMA ICS 2 Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts
3. NEMA ICS 6 Enclosures for Industrial Controls and Systems
4. NEMA KS 1 Enclosed Switches

C. Underwriters Laboratory:

1. UL 508 Standard for Industrial Control Equipment

1.4 SUBMITTALS

A. Submittal Requirements of this section:

1. Thermal manual motor starter switches.
2. Full voltage motor starters.

B. Descriptive Data:

1. Manufacturer's specifications, data sheets.
2. Catalog cuts.
3. Dimensional drawings.
4. Installation Instructions.
5. Wiring & connection diagrams.
6. Capacity ratings, performance curves.
7. Information required to indicate contract compliance.
8. Clearly indicate the exact size or rating proposed.

C. Submit for all motor starters:

1. Material list for each starter indicating:
   a. NEMA rating/size.
   b. NEMA enclosure rating and overall dimensions.
   c. Overload protection type and ranges.
   d. Auxiliary components such as pushbuttons, pilot lights, control transformers, etc.
   e. Switch, fuse or circuit breaker ratings for combination starters.
   f. Type, relays and controls for multi-speed starters.
   g. Type, relays and steps for reduced voltage starters.

D. Closeout Submittals: Submit in accordance with the General Conditions and Division 01 requirements, Section “Common Work Results For Electrical”, and as follows:

1. All post-installation inspection checklists.
2. Installer’s pre-startup checklist.
3. Post installation test results.

1.5 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms “Listed and Labeled”: As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing

Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

3. Where equipment consists of multiple components, the entire assembly or product shall be UL Listed and Labeled, or Labeled by a testing organization acceptable to the Authority Having Jurisdiction per the NEC.

B. Single-Source Responsibility:

1. The complete performance of the assembled system, including all accessories shall be the sole responsibility of the supplier. It is the installer's responsibility to ensure that all factory and field installed accessories and loose components used in the system, meet these specifications, and perform up to the stated and tested standards.

C. Manufacturer/Vendor Requirements:

1. Coordinate the components of the system and their arrangements electrically and mechanically.
2. Manufacturer shall be experienced in manufacturing equipment of the types and capacities indicated that have a record of successful in-service performance for a minimum of 10 years.
3. Maintain, within 50 miles from site, a maintenance and service organization complete with parts inventory and repair facility. Service shall be available on a 24-hour basis.
4. Start up services and post installation tests, as specified.

D. Installation Quality: In accordance with recognized trade organizations and standards.

1.	ANSI	American National Standards Institute
2.	ASME	American Society of Mechanical Engineers
3.	ASTM	American Society for Testing and Materials
4.	IEEE	Institute of Electrical and Electronics Engineers
5.	IEEE C2	National Electrical Safety Code
6.	NEC	National Electrical Code
7.	NECA	National Electrical Contractors' Association "Standards of Installation".
8.	NEMA	National Equipment Manufacturers Association
9.	NESC	National Electrical Safety Code
10.	NETA	National Electrical Testing Association
11.	NFPA	National Fire Protection Association
12.	UL	Underwriter's Laboratories

1.6 COORDINATION

A. General: Coordinate features of controllers and control devices with pilot devices and control circuits provided under mechanical Division covering control systems.

B. Coordinate controllers provided under electrical Divisions with motors provided under mechanical Divisions. Coordinate electrical Division product and installation requirements with approved mechanical Division equipment shop drawings, to include, but not limited to:

1. Coordinate control circuit voltages of coils and control transformers with control systems and/or circuits provided under mechanical Divisions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, provide a system by the named “Basis of Design” manufacturer, or a comparable product of one of the other following named manufacturers:

1. 600VAC motor controllers.
   a. Square D/Schneider Electric (basis of design)
   b. ABB (GE)
   c. Cutler-Hammer
   d. Siemens

2.2 MOTOR CONTROLLERS, GENERAL

A. Coordinate the features of each motor controller with the ratings and characteristics of the supply circuit, the motor, control sequence, motor duty cycle, motor load, pilot device(s), and control circuit affecting controller functions. Provide controllers that are horsepower rated to suit the motor controlled, per drawings.

B. Contacts shall open each ungrounded connection to the motor.

C. Provide solid state overload protection on all individual full voltage, reduced voltage and solid state controllers, and on controllers furnished as part of an assembly or Motor Control Center.

1. Overload circuit shall provide for 3:1 FLA range.
2. Adjustable dial marked in true amperes (those marked with percentage of nominal or other relative scales are not acceptable.
3. 2% tripping accuracy.
4. True single phase protection by detecting loss of, or low voltage and tripping within 3 seconds.
5. Inherently protection from short circuit damage by saturation of current sensors.
6. Square D Motor Logic Overload Relay, or comparable product from one of the previously listed manufacturers.

D. Enclosures: For individually mounted motor controllers and control devices, comply with NEMA 250, “Enclosures for Electrical Equipment (1000 Volts Maximum).” Provide enclosures suitable for the environmental conditions at the controller location, as follows, (unless indicated otherwise):

1. NEMA 1 for interior.
2. NEMA 3R for exterior, damp, or wet locations, on roof or on grade.

2.3 THERMAL MANUAL MOTOR STARTING SWITCHES

A. Provide for fractional HP motors (1 HP and less) without factory overload protection, and as indicated.

1. NEMA ICS 2, AC general purpose, Class A, manually operated, full-voltage controller with overload element.
2. Manual operated toggle switch type. Quick make and break type with self indicating trip free handle.

3. Melting alloy thermal overload, interchangeable type.
4. Switch shall not operate without thermal unit.
5. Size thermal unit per motor FLA's.
6. Enclosure: NEMA 1 for interior use and NEMA 4 stainless steel or cast iron for exterior, damp, or wet locations.
7. Handle guard with locking provisions.
8. Flush mounted in finished areas.
9. HOA switches: Where indicated.
10. Pilot light (red) mounted in the same enclosure.
    a. Switches more than 25 feet from motor or out of sight from motor.
    b. Where indicated.
11. Square D Class 2510, or comparable product by previously named manufacturers.

B. For motors 1 HP, manual starters shall be as above except;

1. Square D Class 2510 Type M, or comparable product by previously named manufacturers.

2.4 GENERAL PURPOSE RELAYS

A. For control of small fans, pumps, etc. as indicated, from ATC or HVAC control circuits.

1. Plug-in type with blade type connections.
2. Matching base for screw terminations of control and power wiring. NEMA 1 enclosure for mounting of relay and base.
3. Power contacts rated 120 volt, 10 amps, SPST, SPDT as required, rated for motor duty through 2 HP.
4. Coil voltage per Division 15 for proper interface between control wiring and relay coils.
5. Square D Class 8501, or equal.

2.5 FULL VOLTAGE MAGNETIC MOTOR STARTERS

A. NEMA ICS 2, ac general-purpose Class A magnetic controller for induction motors, full-voltage, magnetic type, non-reversing, across-the-line, controller, except where another type as indicated.

1. NEMA horsepower rated, 600 VAC, 3 pole, 60 Hz.
2. NEMA Size as per drawings. Minimum Size 0.
3. NEMA enclosure as specified previously.

B. Provide all starters with the following accessories unless noted otherwise:

1. Red "RUNNING" pilot light.
2. N.O./N.C. auxiliary contacts.
3. Control Power Transformer with Prim/Second Fusing.
4. Hand-Off-Automatic selector switches.
5. Solid state overload, single phasing and phase loss protection, as specified previously.

C. Provide starters with the following accessories, as indicated on drawings:

1. Start-stop pushbuttons.

2. Green "OFF" pilot light

D. Full voltage, non-reversing AC magnetic starters.

1. Square D Company Class 8536 Type S, or comparable product by previously named manufacturers.

E. Combination starters with fused disconnect switches.

1. Factory wired NEMA KS 1, enclosed knife switch with externally operable handle and visible blades.
2. Quick-make, quick-break switch with external operator handle
3. Interlock switch with unit cover or door.
4. Rejection clip fuse holder and UL Class R fuses, as indicated.
5. Square D Class 8538 Type S, or comparable product by previously named manufacturers.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions: Examine the conditions under which the equipment shall be delivered, installed, and operated. Make all allowances required for operation, access and maintenance of the equipment, per Codes and manufacturers.

3.2 INSTALLATION - INDEPENDENT CONTROLLERS

A. General:

1. Install independently mounted motor control devices in accordance with manufacturer’s written instructions.
2. Install all equipment, as indicated.
3. Maintain minimum working space at live parts according to manufacturer’s written instructions and NEC.
4. Provide all required access space per NEC for controls, fuses and items requiring maintenance access.

B. Location:

1. Locate controllers as indicated and within sight of motors controlled.
2. Install with proper clearances as required for access, operate, service and/or adjust, per manufacturer and NEC requirements.

C. Mounting:

1. Wall mounting: Bolt units to wall or mount on light-weight structural steel channels bolted to the wall.
2. For controllers not at walls, provide freestanding racks fabricated of structural steel members and slotted structural steel channels. Use channel manufacturer’s standard L mounting plates, bolted to the floor. Connect the posts with horizontal slotted steel channels and bolt the control equipment to the channels.
3. For rooftop equipment, it shall be acceptable to mount controllers to equipment frames, etc. where suitable support is available.

3.3 IDENTIFICATION

A. Identify motor control components and control wiring in accordance with Section "Common Work Results For Electrical".

1. Provide engraved nameplate for each individual controller, and each MCC cubicle, which identifies the motor or load per project nomenclature.

B. Provide permanent warning signs on all motor control centers, on room doors, and on fenced yards containing such equipment. Warning signs shall be as specified in section "Common Work Results for Electrical".

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between motor control devices and control/indicating devices as specified in Section "Low Voltage Power Conductors and Cables" for hard-wired connections.

B. Install wiring in enclosures neatly bundled, trained, and supported.

3.5 CONSTRUCTION

A. Interface with Other Work:

1. Provide connections between proposed motor control equipment and other work of this contract:
   a. Motors
   b. Variable Frequency (speed) Drives
   c. Automatic temperature control systems.
   d. Remote pushbuttons, HOA switches, or other manual control points.

B. Grounding: Ground motor controllers and motor control center equipment frames and enclosures per NEC and as specified in Section "Grounding & Bonding For Electrical Systems".

C. Connections: Tighten all connectors, terminals, lugs, etc. including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torque requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors."

3.6 FIELD QUALITY CONTROL

A. Install and test all motor control devices per NEMA ICS 2.

B. Reports: Prepare written reports certified by testing organization of tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made.

C. Schedule visual and mechanical inspections and electrical tests with at least one week's advance notification to Owner and Architect.

D. Pretesting: On completing installation of the system, perform the following preparations for tests:

1. Provide insulation resistance tests of conducting parts of motor control components; and of connecting supply, feeder, and control circuits. For devices containing solid-state components, use test equipment and methods recommended by the manufacturer.
2. Make continuity tests of all circuits.

E. Visual and mechanical inspection: Include the following inspections and related work.

1. Overload protection and control settings:
   a. Set solid state overload settings based on motor FLA's, service factor and temperature rise, per NEC
   b. Provide proper setting of all current and time acceleration and deceleration ramps, overload protection devices, current limitation, etc. as determined by ATC system installer and/or control system installer. Programmer shall work in conjunction and with the ATC system installer to provide proper settings for motor operation.
2. Inspect for defects and physical damage NRTL labeling, and nameplate compliance with current project drawings.
3. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instructions.
4. Check tightness of electrical connections of devices with calibrated torque wrench. Use manufacturer's recommended torque values.
5. Clean devices using manufacturer's approved methods and materials.
6. Verify proper fuse types and ratings in fusible devices.

F. Electrical Tests: Perform the following in accordance with manufacturer's instructions:

1. Insulation resistance test of motor control devices conducting parts to the extent permitted by the manufacturer's instructions. Insulation resistance less than 100 megohms is not acceptable.
2. Use primary current injection to check performance characteristics of motor-circuit protectors and for overload relays of controllers for motors 15 horsepower and larger. Trip characteristics not within manufacturer's published time-current tolerances are not acceptable.
3. Test auxiliary protective features such as loss of phase, phase unbalance and undervoltage to verify operation.
4. Check for improper voltages at terminals in controllers that have external control wiring when controller disconnect is opened. Any voltage over 30 V is unacceptable.
5. Test ground fault protection devices by current injection method.
6. Test for proper phasing of all motors, controllers, etc.
7. Retesting: Correct deficiencies and retest. Verify by the retests that specified requirements are met.

3.7 ADJUSTING

A. General:

1. Set all field adjustable parameters to those as specified.
2. Set solid state overload sensors and devices to 115%-125% of motor nameplate FLA's, per NEC Art. 430.
3. Select and install thermal, melting alloy type overload protection at 115%-125% of motor nameplate FLA's, per NEC Art. 430.

4. Set field adjustable pickup and time delay ranges of Ground Fault Systems, as indicated, for coordination with upstream protection devices. GFP pickup settings for motors feeder protection shall not exceed 80% of the value of the upstream overcurrent protection device setting.
5. Auto-transformer starters: Set reduced voltage starting tap at 65% of nominal voltage.
6. Soft start solid state motor starters:
   a. Inrush current limiting: Set at 300% of FLA's.
   b. Acceleration/deceleration ramping time: Set as required for each motor/load to achieve steady acceleration under load.
   c. Acceleration/deceleration current adjustments: Set as required for each motor/load to achieve steady acceleration under load.
   d. Stopping method: Set for freewheel, solid state soft-stop, and/or intelligent braking as required for application.

3.8 CLEANING

A. General:

1. Inspect interior and exterior of installed equipment.
2. Remove paint splatters and other spots, dirt, and debris.
3. Touch up scratches and mars of finish to match original finish.
4. Remove protective films, etc. from all devices, controls, etc.
5. Remove debris, insulation and wire clippings, dirt, etc. from interior of all equipment.
6. Remove dirt, debris, etc. from top of all equipment.

3.9 DEMONSTRATION

A. Owner Demonstrations: Provide a factory trained representative for each system and type of equipment, for the purpose of training owner's personnel:

1. Discuss proper operation, maintenance, and use of all equipment.
2. Demonstrate periodic Owner testing and/or inspection of equipment.
3. Demonstrate adjustment to Owner-accessible equipment and systems.
4. Instructors shall be fully knowledgeable of the installed equipment and all components.
5. Training shall be completed at the project site following Owner occupancy, at Owner's discretion.
6. Schedule after all final tests, adjustments and Owner's acceptance.
7. Training shall include sufficient time for owner training and instruction, including use of delivered O&M manuals for each system or equipment.

END OF SECTION

SECTION 263100

PHOTOVOLTAIC SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section provides requirements for a complete and functional contractor/vendor design, procurement, installation, testing, commissioning and maintenance for a roof-top photovoltaic grid-tie, energy production system.

B. Section Includes:

1. PV system description.
2. Manufactured PV modules..
3. PV module framing.
4. PV array construction.
5. DC wiring system, conductors and raceways.
6. DC system overcurrent and overvoltage protection.
7. DC to AC Inverters.
8. System overcurrent protection.
9. Mounting structures.
10. Interconnection with building and/or utility power system.
11. Coordination with local utility company.

C. Related Sections:

1. Section “Common Work Results For Electrical.”
2. Section “Grounding & Bonding For Electrical Systems” for grounding, bonding and interconnection of equipment to building and service grounds.

D. Permits and Fees:

1. Apply for, make payment, secure and obtain all necessary and required permits relative to work of this section.

E. Utility Coordination:

1. Provide all coordination with local utility for interconnection, net-metering, etc. of the proposed PV system, including all utility applications, energy production calculations, etc. as required by utility company.

1.3 SYSTEM DESCRIPTION

A. The PV system described in this document is a facility-scale less than 1 megawatt with system voltage not exceeding 1,000 VDC, single PV systems with a single service, and is of the grid-connected type which provides a direct interconnection of PV system and grid power service supplying building that has backup power systems that would never operate in parallel with the grid power and PV system because backup power generator is supplying power via an automatic transfer switch. The PV system does not include battery/backup storage or secondary electrical generation devices. PV system feeds AC power into the local services when solar energy is available and immediately disconnects from the grid upon loss of grid power to the service in accordance with IEEE 1547and local utility regulations

B. PV system must comply with these specifications, all applicable construction document drawings, all applicable codes, and all local authorities having jurisdiction. System must comply with all policies and standards required by the electrical utility having jurisdiction and all applicable incentive program guidelines. PV system equipment includes, but is not limited to, PV modules and electrical insulating components such as encapsulants and backsheets, raceways, inverters, combiner boxes, disconnect switches, wire, conduit, junction boxes, mounting hardware, mounting structure for modules (racking), monitoring and communication equipment.

C. Provide surge protective device (SPD) complying with NFPA 780 requirements and listed to UL 1449.

D. Design Requirements:

1. System design shall be by certified PV system designer or registered Professional Engineer qualified in Photovoltaic System System design.
2. Component sizing and selection for a complete system.
3. Design shall appear as a part of the building or structure, with conductors concealed within columns, walls and roof construction, where possible and practicable.
4. Select locations for equipment, which shall minimize need to disturb for future building maintenance and repair of roofing.
5. Final PV system design shall be signed/sealed by a licensed professional engineer in the state of Maryland.

E. Performance Requirements: This is a performance specification. It is the full responsibility of the installer to ensure that the design and installation conforms to all applicable standards and Codes.

1. Minimum PV System Requirements (Basis of Design)
   a. Number of Arrays: two (2)
   b. Peak Power Output (minimum): 138 KW
      1) Array #1: 71 KW
      2) Array#2: 67 KW
   c. Approximate Qty of PV Modules: 266
      1) Array #1: 133
      2) Array#2: 123
2. Single point tie in to utility power.

1.4 SUBMITTALS

A. General: Submit each item in this Section according to the conditions of the contract and Division 01 Specification Sections.

B. Submittals shall also comply with the submittal procedures and requirements of electrical Specification Sections.

A. Submittal Requirements of this section:

1. Roof plan showing system components.
2. Manufactured PV modules..
3. PV module framing & mounting structures.
4. PV array construction.
5. DC wiring system, conductors and raceways.
6. DC system overcurrent and overvoltage protection.
7. DC to AC Inverters.
8. System overcurrent protection devices.
9. Rooftop wiring diagrams.
10. Ground and bonding connections.
11. Roof ballast system.
12. All other miscellaneous hardware.

B. Descriptive Data:

1. Manufacturer's specifications, data sheets.
2. Catalog cuts.
3. Dimensional drawings.
4. Installation Instructions.
5. Clearly indicate the exact size or rating proposed.
6. To verify specifications have been met/exceeded.
7. Indication of UL Listings.
8. Clearly indicate or state options, etc.:
    a. Manufacturer/catalogue number.
    b. Construction data, materials, as applicable.
    c. Label each conductor or cable type, and its proposed application or location.
    d. Identify each component with a cross reference to the drawings.
    e. Drawings and installation instructions.
    f. Details to demonstrate that the system has been coordinated and will function as one unit.

C. System Design Drawings:

1. Identify each component used in the system.
2. Indicate all building penetrations, and method proposed at each location.
3. Indicate attaching methods for all components.
4. Indicate proposed layout, including relationship to other parts of work.
5. Show proposed protection for all building accessories, roof top equipment, etc.
6. Drawings shall be stamped and signed by a licensed PV System engineer.
7. Include plans, elevations, sections, and mounting details.
8. Include details of equipment assemblies. Indicate dimensions, weights, loads,

required clearances, method of field assembly, components, and location and size of each field connection.

9. Detail fabrication and assembly.
10. Include diagrams for power, signal, and control wiring.

D. LEED Submittals
1. EA Credit 5: Renewable energy
a. Provide documentation showing total annual production of solar array.

E. Closeout Submittals: Submit in accordance with the General Conditions and Division 01 requirements, Section “Common Work Results For Electrical”, and as follows:

1. Post installation commissioning and performance testing of the PV system.
2. Field quality-control reports.
3. Sample Warranty: For manufacturer's special materials and workmanship warranty and minimum power output warranty.
4. Operation and Maintenance Data: For PV modules to include in operation and maintenance manuals.

1.5 DEFINITIONS

A. CEC: California Energy Commission.

B. ETFE: Ethylene tetrafluoroethylene.

C. FEP: Fluorinated ethylene propylene.

D. IP Code: Required ingress protection to comply with IEC 60529.

E. MPPT: Maximum power point tracking.

F. PTC: PVUSA Test Condition. Commonly regarded as a "real-world" measure of PV output. See below for definition of "PVUSA."

G. PV: Photovoltaic.

H. PVUSA: Photovoltaics for Utility Systems Applications.

I. STC: Standard Test Conditions defined in IEC 61215.

1.6 ELECTRONIC AUTOCADD DOCUMENTS

A. Requests for electronic Autocadd documents will be accommodated to the contractors and installers upon receipt of Bowman’s Electronic Document Release Form. Refer to Section “Common Work Results for Electrical” for additional information.

1.7 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

B. The Terms “Listed and Labeled”: As defined in the National Electrical Code, Article 100 (NEC).

C. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.

D. Where equipment consists of multiple components, the entire assembly or product shall be UL Listed and Labeled, or Labeled by a testing organization acceptable to the Authority Having Jurisdiction per the NEC.

E. Manufacturer’s Requirements:

1. Engaged in manufacturing of PV systems and equipment at least 10 years.
2. Provide local maintenance and service with location less than 100 miles from project site.
3. Provide technical support to installer.
4. Maintain, within 50 miles from site, a maintenance and service organization complete with parts inventory and repair facility.
5. Materials shall be UL listed.

F. Single-Source Responsibility:

1. The complete installation and performance of the installed system, including all accessories shall be the sole responsibility of the PV system installer. It is the installer’s responsibility to ensure that all field installed accessories and loose components used in the system, meet these specifications, and perform up to the stated and tested standards.
2. Coordinate the components of the system and their arrangements electrically and mechanically.

G. Installer Qualifications:

1. Has installed a minimum of fifteen (15) PV systems of similar size and conditions within the local area.
2. Factory-authorized installer to perform work of this Section.
3. Provide references upon request:
   a. Names of six (6) similar projects in size and scope.
   b. Contact person and phone number for each project.

H. Installation Quality: In accordance with the following Codes and Standards.

1. NEC National Electrical Code
2. NETA National Electrical Testing Association
3. NFPA National Fire Protection Association
4. UL Underwriters Laboratories

I. Certification of all system components:

1. Catalogued by the system manufacturer.
2. UL Listing of each component individually.

1.8 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection:

1. Store all materials under cover, in trailers, buildings, etc.
2. Protect all materials from physical damage and exposure to weather, prior to installation.

1.9 PROJECT CONDITIONS

A. The PV system and components shall be installed on the structure rooftop. Refer to all other project specification sections and drawings for coordination with roof, structural and mechanical systems.

1.10 SEQUENCING

A. General Sequencing:

1. Coordinate PV system installation with roof, steel, mechanical and electrical components and construction.
2. Coordinate PV system installation with mechanical system components on roof, grade, etc. Do not install PV components prior to completion of mechanical equipment on roof.
3. Coordinate PV system installation with lightning protection system components on roof.
4. Provide for roof penetrations.
5. Coordinate PV system interconnections with building electrical system and utility metering.

1.11 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of PV modules that fail in materials or workmanship within specified warranty period.

1. Manufacturer's materials and workmanship warranties include, but are not limited to, the following:

a. Faulty operation of PV modules.
b. Glass breakage.

2. Warranty Period: Twelve (12) years from date of Substantial Completion.

B. Manufacturer's Special Minimum Power Output Warranty: Manufacturer agrees to repair or replace components of PV modules that fail to exhibit the minimum power output within specified warranty period. Special warranty, applying to modules only, applies to materials only, on a prorated basis, for period specified.

1. Manufacturer's minimum power output warranties include, but are not limited to, the following warranty periods, from date of Substantial Completion:

a. Specified minimum power output to 80.68 percent or more, for a period of twenty five (25) years.

1.12 MAINTENANCE AND INSPECTION

A. Term: Beginning at Commercial Operation Date for the Solar PV System, provide five year's inspection and maintenance services by skilled employees of installer's approved service organization.

B. Inspection: The following activities should be performed as part of a low-rigor inspection program at a frequency of at least twice per year. Personnel performing system inspections must follow all Occupational Safety and Health Administration (OSHA) requirements regarding safety. Although none of the activities described in this section requires the individual to access or work with electrical conductors or equipment, staff should be trained to work near high-voltage electrical systems.

1. Investigate the data that the monitoring system or production meter generates to confirm that performance aligns with expectations and that no data is missing or erroneous.
2. Remove any vegetation or debris that may be shading the modules and ensure that no new objects like satellite dishes are shading the array.
3. Observe whether excessive soiling may require cleaning to be scheduled.
4. Look for signs of animal infestation, such as nests, excessive bird droppings, or wires that have been chewed on.
5. Take note of any wire connectors emanating from the modules that do not appear to be well connected.
6. Record the location of any wires that are poorly fastened to the racking structure, that are rubbing against an abrasive surface, that are showing breakdown from ultraviolet exposure, or that are bent in such a way that might damage the integrity of the conductor.
7. Inspect the modules for discoloration, signs of breakage, delamination, vandalism, or theft.
8. Ensure that roof drainage is not blocked and that there are no signs of pooled water near the array or conduit
9. Verify that conduit is well supported and firmly intact.
10. Ensure roof penetrations are water tight and that no damage is apparent on the rooftop.
11. Confirm that the racking system is structurally secure and shows no signs of corrosion.
12. Visually inspect the exterior of all electrical cabinets, such as combiner boxes, junction boxes, disconnects, and inverters for corrosion, discoloration, debris, and solid attachment to a stable structure.
13. Check that all inverters are operational, and record the inverter error logs.
14. Lastly, thermal imaging using infrared equipment can be used to record the location of excessive heat dissipation in module cells, wire connections, and electrical cabinets (only the exterior of electrical cabinets should be imaged).

C. Maintenance: The following activities should be performed as part of a high-rigor maintenance program with a frequency of once per year or as issues arise. Individuals performing maintenance on a PV system must follow all OSHA requirements regarding safety. Because many of these tasks involve working with high-voltage conductors and electrical equipment, the staff must meet the National Electrical Code's (NEC's) definition of "qualified personnel." Due to the high direct current (DC) voltages that can be present in PV systems, staff must be trained in arc flash protection and wear all appropriate arc flash protection equipment.

1. Ensure sensors related to the data monitoring systems are properly attached and orientated and clean irradiance sensors.
2. Compare readings from sensors to recently calibrated sensors to ensure sensor accuracy, and check the voltages of power supplies to the sensors and communication devices.

3. Measure the power at the production meter, and compare it to the meter's readings to ensure meter accuracy.
4. Clean modules.
5. Eliminate opportunities for animal infestation.
6. Reconnect any loose wire connectors.
7. Fasten any hanging wires to a supportive structure, and repair or replace any damaged wires.
8. Replace broken, delaminated, malfunctioning, or stolen modules.
9. Correct any issues with water drainage or any issues that are degrading the integrity of the rooftop.
10. Repair conduit that is not intact or firmly supported.
11. Correct any issues with the structural integrity of the racking system, and replace any corroded components.
12. Verify the continuity of all equipment grounding of racking systems, junction boxes, combiner boxes, disconnects, and inverters.
13. Replace or repair any corroded electrical cabinets, and ensure that all electrical cabinets are weather tight.
14. Measure module string open-circuit voltage, maximum power current, and short-circuit current, and compare these measurements against expected values or perform I-V curve tests to identify malfunctioning modules.
15. Perform Megger resistance tests to verify that wire insulation is intact and suitable.
16. Test continuity of system grounds to all major components.
17. Test continuity of fuses in combiner boxes, disconnects, and inverters; tighten all wire terminals; and inspect components for discoloration or excessive heat dissipation.
18. Measure the DC input power and alternating current (AC) output power from the inverter and confirm that appropriate efficiencies are being realized and that inverter readings are accurate.
19. Clean or replace air filters on inverters.
20. Test fans on inverters for proper operation.
21. Use infrared thermal imaging to identify faulty wire connections and subcomponents within electrical cabinets.
22. Coordinate installation with all other trades.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, provide a system by one of the following named manufacturers, or approved equals:

B. PV Modules:
1. Trina Solar
2. Qcells
3. Canadian Solar
4. First Solar

C. DC-AC Inverters:
1. Siemens
2. Solar Edge
3. Yaskawa Solectria Solar
4. TMEIC

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 PV CAPACITIES AND CHARACTERISTICS

A. Minimum Electrical Characteristics:

1. Rated Open-Circuit Voltage: 37.5V DC.
2. Maximum System Voltage: 1500V DC.
3. Maximum Power at Voltage (Vmpp): 31.2V DC
4. Short-Circuit Temperature Coefficient: -0.25%/deg C.
5. Rated Short-Circuit Current (Isc): 18.41A.
6. Maximum Power Current (Impp): 17.33A.

B. Additional Electrical Characteristics:

1. Series Fuse Rating: 30A.

C. Normal Operating Temperature Characteristics (NOTC):

1. Temperature at Nominal Operating Cell Temperature: 43 deg C.
2. Temperature Coefficient (NOTC Open-Circuit Voltage): -0.25%/deg C.
3. Temperature Coefficient (NOTC Short Circuit Current): 0.04%/deg C.
4. Temperature Coefficient (NOTC Maximum Power Voltage): -0.34%/deg C.

2.4 PV SYSTEM DESCRIPTION

A. Collectors connected to provide power ac loads, connected to utility through interactive inverters.
1. System Components:

a. PV modules.
b. Array frame.
c. Charge controller.
d. System control.
e. Inverter
f. Overcurrent protection, disconnect, and rapid shutdown devices.
g. Mounting structure.

2.5 MANUFACTURED PHOTOVOLTAIC MODULES

A. Cell Materials: Monocrystalline.

B. Module Construction:

1. Nominal Size: 43.15 inches (1096 mm) wide by 93.85 inches (2384 mm) long.
2. Weight: 62.39 lb (28.3 kg).

C. Encapsulant: Ethyl vinyl acetate.

D. Front Panel: Fully tempered glass.
1. 0.13-inch- (3.2-mm-) thick glass.

E. Backing Material:
1. White.

F. Bypass Diode Protection: Internal.

G. Junction Box:
1. IP Code: IP 68.

H. Output Cabling:
1. Photovoltaic Technology Cable 4.0 mm2 (0.006 inches2)
2. Portrait: 350/280 mm(13.78/11.02 inches)
3. Length can be customized.

I. Series Fuse Rating: 30A.

2.6 PV MODULE FRAMING

A. PV laminates mounted in anodized extruded-aluminum frames.

1. Entire assembly UL listed for electrical and fire safety, Class A, according to UL 1703, and complying with IEC 61215.
2. Frame strength exceeding requirements of certifying agencies in subparagraph above.
3. Finish: Anodized aluminum.

a. Alloy and temper recommended by framing manufacturer for strength, corrosion resistance, and application of required finish.
b. Color: As indicated by manufacturer's designations.

2.7 INVERTER

1. Array-to-inverter kW ratio must not exceed manufacturer recommendations. Inverter must be IEEE 1547 compliant, listed to UL 1741, comply with the latest applicable ANSI and FCC standards and addenda, and inspected before commissioning, testing, and operation of the system. Submit documentation validating system performance requirements.
2. All same-sized inverters supplied must be of the same manufacturer and model number.
3. Provide inverter with anti-islanding protection to prevent back-feeding inverter generated power to the grid in the event of a utility outage. Anti-islanding protection must be listed to UL 1741 and IEEE 1547.
4. Overcurrent protection, ground fault protection, arc fault circuit interrupter (AFCI), and rapid shutdown must comply with the requirements of NFPA 70.

2.8 SYSTEM OVERCURRENT PROTECTION

A. Circuit Breakers: 175A

2.9 MOUNTING STRUCTURES

A. Flat-Roof Mounting:

1. No roof penetrations.
2. Self-ballasting.
3. Wind-tunnel tested.
4. Service Life: 25 years.

2.10 GROUNDING AND BONDING

A. Provide properly sized equipment grounding conductors. Equipment grounding conductors must be insulated stranded copper, except that sizes 10 AWG and smaller must be solid copper. Insulation color must be continuous green for all equipment grounding conductors, except that wire sizes 4 AWG and larger shall be identified per NFPA 70.

B. Provide grounding lugs for aluminum PV solar module frames of either stainless steel or tin-coated copper.

C. Bonding conductors must be bare stranded copper, except that sizes 10 AWG and smaller must be bare solid copper. Bonding conductors must be stranded for final connection to motors, transformers, and vibrating equipment.

D. Provide bonding fittings on concentric/eccentric knockouts with metal conduits for circuits over 250 volts in accordance with NFPA 70.

E. Provide bonding fittings for ferrous metal conduits enclosing grounding electrode conductors in accordance with NFPA 70.

2.11 LIGHTNING PROTECTION SYSTEM

A. Provide PV Lightning Protection for electrical and mechanical systems in accordance with Section 26 41 13 LIGHTING PROTECTION SYSTEM and NFPA 780.

PART 3 - EXECUTION

A. EXAMINATION: Site Verification of Conditions: Examine the conditions under which the equipment shall be delivered, installed, and operated. Make all allowances required for installation and maintenance of the equipment, per Codes and component manufacturers.

B. Examine substrate areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

C. Do not begin installation until mounting surfaces have been properly prepared.

D. If preparation of mounting surfaces is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Examine modules and array frame before installation. Reject modules and arrays that are wet, moisture damaged, or mold damaged.

F. Examine roofs, supports, and supporting structures for suitable conditions where PV system will be installed.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General Requirements:
1. Install all equipment, as indicated and per manufacturer's written instructions.
2. Do not install equipment where location impedes access to other equipment or creates unsafe conditions. Install in suitable, alternate location.
3. Coordinate the installation of the PV system with the work of other trades and contractors prior to laying out system or beginning work.
4. Coordinate layout and installation of PV panels with roof assembly and other construction.

B. Comply with NECA 1.

C. Support PV panel assemblies independent of supports for other elements such as roof and support assemblies, enclosures, vents, pipes, and conduits. Support assembly to prevent twisting from eccentric loading.

D. Install PV inverters in locations coordinated with all disciplines and roof equipment.

E. Install weatherseal fittings and flanges where PV panel assemblies penetrate exterior elements such as walls or roofs. Seal around openings to make weathertight. See Section 079200 "Joint Sealants" for materials and application.Field Wiring:

1. Comply with National Electrical Code.
2. Install all AC power cabling in conduit or metal raceway according to Section "Raceways & Boxes for Electrical Systems."
3. Exposed raceways shall be properly supported per NEC and PV system manufacturer.
4. Do not mix PV system cabling in same raceways/boxes with wiring of any other systems.
5. Do not run PV system conduits parallel and within 18" of any other AC or DC system cabling or conduits.
6. Install all cables in raceways.
7. Furnish and install conductors required to connect incoming and outgoing circuits.
8. Install conductors with conduits, boxes, and terminal cabinets in a totally enclosed installation.

F. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

G. Disconnects:

1. Provide disconnecting means in accordance with NFPA 70 requirements.
2. Install disconnects for all current carrying conductors of the PV source.
3. Install disconnects for the PV equipment. For inverters and other equipment that are energized from more than one source, group and identify the disconnecting means. Equipment disconnecting means or its remote operating device or the enclosure

providing access to the disconnecting means must be capable of being locked in the open position when not within sight or not within 10 ft of the equipment.

4. Install disconnects and overcurrent protection for all ungrounded conductors in ungrounded (transformerless) PV power systems.
5. Install disconnecting means with a rapid shutdown function using the rapid shutdown initiation devices as specified in NFPA 70. Each device's "off" position must indicate that the rapid shutdown function has been initiated for all PV systems connected to that rapid shutdown initiation device.
6. Disconnecting means equipment that performs the rapid shutdown function, other than initiating devices, must be listed for providing rapid shutdown protection.
7. Buildings with rapid shutdown disconnecting means must have a permanent label as specified in NFPA 70.

H. Overcurrent and Overvoltage Protection:

1. Install the PV interconnect overcurrent protective device as indicated in accordance with NFPA 70. Overcurrent devices used in PV system dc circuits must be listed for use in PV systems.
2. Install overvoltage surge protective device (SPD) as indicated and in accordance with NFPA 780 and NFPA 70. PV surge protective devices must be listed for use in PV system and marked "DC" or "PV SPD." If the system inverter is more than 30 m 100 ft from the closest combiner or recombiner box, provide additional PV SPDs at the PV output circuit adjacent to the inverter.

I. PV System Grounding:

1. NFPA 70 and IEEE C2, except provide grounding systems with a resistance to solid earth ground not exceeding 25 ohms. Ground according to racking manufacturer's recommendations.
2. Install grounding lugs in locations on the solar PV module as designated by the module manufacturer, using stainless steel machine screws of the thread size provided in the pre-tapped holes, along with a stainless steel star washer placed between the grounding lug and the solar module frame.

3.3 CONNECTIONS

A. Coordinate PV panel cabling to equipment enclosures to ensure proper connections.

B. Coordinate interconnection of utility with BGE prior to rough-in including but not limited to service application and all correspondence with BGE.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

D. Make splices, terminations, and taps that are compatible with conductor material.

3.4 FIELD QUALITY CONTROL

A. Installation shall meet all the requirements of NEC and component manufacturers.

B. Installer's Field Services:

1. Provide services of a factory-authorized service technician to make all connections of all system cabling at modules, combiners, disconnects, inverters and associated components and accessories.
2. Be present and supervise all pretesting of PV system prior to connections to utility power.
3. Be present and supervise the adjustment of all settings, components and accessories.
4. Provide all system adjustments, fine tuning, etc., based on project conditions.
5. Assist in the troubleshooting, as necessary to provide a system free from all faults, trouble conditions, etc. prior to required testing by AHJ.

C. Inspections by AHJ:
1. Arrange all required inspections by the local Fire Department, Fire Marshal, and/or Authority Having Jurisdiction
2. Notify all parties, including owner and architect, at least 2 weeks in advance of scheduled Inspections.
3. Attend all inspections of system, wiring, etc. by local authorities.
4. Document and distribute results of testing to all parties.
5. Perform all adjustments, changes, etc. required.
Provide for re-inspections, if required.
6. Address and correct all inspection deficiencies such that system passes all required inspections and certifications.

D. Utility Coordination:

1. Schedule and attend all inspections of system, wiring, etc. by local utility company.
2. Comply with all utility requirements for interconnecting with utility power.
3. Provide and submit all required documentation to utility for interconnection and net utility metering.
4. Address and correct all inspection deficiencies such that system passes all required inspections and certifications.

E. Site Tests:

1. Schedule tests and provide notification at least one week in advance of any test commencement.
2. PV System Module Electrical Testing:
    a. Continuity measurements.
    b. Open circuit voltage.
    c. Short circuit current.
    d. Insulation resistance.
    e. Irradiance.
    f. Individaul PV module outputs.
    g. DC Withstand test (negative and positive polarity)
3. PV Inverter Electrical Testing:
    a. Verify input voltages to inverter from array.
    b. Verify AC output voltages with fluctuating DC inputs.
    c. Verify anti-islanding for shutdown upon loss of utility power.
    d. Verify PV system remains OFF when building is running on generator power.
4. Post-Installation Testing: After completing system installation, perform the following preparations for tests:
    a. Make ground resistance tests for system, per Section “Grounding & Bonding For Electrical Systems.” Verify proper grounding of all rooftop metal structures and framing.

b. Inspect accessible components for cleanliness, mechanical, and electrical integrity, for presence of damage or deterioration. Correct all deficiencies are corrected.
c. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, where not available, those of UL Standards 486A, “Wire Connectors and Soldering Lugs for Use with Copper Conductors.” Provide a written inspection checklist, which verifies all components have been inspected and are satisfactory.

3.5 DEMONSTRATION

A. System Installer shall provide a factory trained representative for purpose of training owner's personnel:

1. Discuss proper operation, maintenance, and use of system.
2. Instructor shall be fully knowledgeable of the installed system and all components.
3. Training shall be completed at the project site following Owner occupancy.
4. Schedule after all final tests, adjustments and Owner's acceptance.
5. Training shall include use of delivered O&M manuals.

END OF SECTION 263100

SECTION 26 32 00

PACKAGED GENERATOR ASSEMBLIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Section Includes:

1. Diesel powered generator(s).
2. Weatherproof Sound Enclosures.
3. Subbase fuel tank.
4. Service platform.
5. Auxiliary equipment.

B. Related Sections:

1. Section “Common Work Results For Electrical” for concrete pads requirements.
2. Section “Grounding & Bonding For Electrical Systems” for grounding, bonding and interconnection of equipment.
3. Section “Low Voltage Electrical Power Conductors and Cables” for grounding conductors and attachments and conductors used of low voltage controls.
4. Section “Raceways and Boxes for Electrical Systems” for raceways and conduit requirements for generator connections, etc.
5. Section “Low Voltage Electrical Distribution” for generator output circuit breaker requirements.
6. Section “Transfer Switches” for coordination with power switching and control equipment.
7. Section “Commissioning of Electrical Systems” for specific commissioning and functional performance testing requirements of the generator system(s).

C. Permits and Fees:

1. Apply, pay for and secure all permits, required by the Authorities Having Jurisdiction prior to start of work, in accordance with contract General Conditions and Division 01.
2. For projects in the State of Maryland, provide the following:
   a. Contractor shall complete, file, pay for, and secure a “Permit to Construct - Application for Fuel Burning Equipment” (Form 11) from the Maryland Department of the Environment (MDE).
3. Deliver all certificates to the Owner prior to final acceptance of work.

1.3 REFERENCES

A. IEEE:

1. IEEE 241 IEEE Recommended Practice for Electric Power Systems in

Commercial Buildings

2. IEEE 446 IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications

B. National Electrical Code (NEC):

1. NEC 700 Emergency Systems
2. NEC 701 Legally Required Standby Systems
3. NEC 702 Optional Standby Systems

C. National Fire Protection Association (NFPA):

1. NFPA 70 National Electrical Code
2. NFPA 110 Emergency And Standby Power Systems

B. National Equipment Manufacturers Association (NEMA):

1. NEMA Standards of Construction and Testing.
2. NEMA MG-1 Motors and Generators

C. Underwriters Laboratories (UL):

1. UL 508 Industrial Control Equipment
2. UL 2200 Standard for Safety for Stationary Engine Generator Assemblies

1.4 SUBMITTALS

A. Submittal Requirements of this section:

1. Engine-generator assembly.
2. Sound attenuating enclosure.
3. Engine muffler/silencer.
4. Engine control panel and instrumentation.
5. Remote status panel.
6. Subbase fuel tank.
7. Engine jacket heater.
8. Battery charger.
9. Starting batteries.
10. Service Platform.

B. Basis-of-Design Comparable Products Submission:

1. Contract Drawings are based on only the named “Basis of Design” manufacturer and model of generator, alternator and specified accessories.
2. Engineer has not verified that any Comparable Products by manufacturers other than the “Basis of Design” equipment will properly fit, perform or meet the design intent and contract documents.
3. Contractor must verify sizes, ratings, dimensions, clearance requirements, weight, fuel flow and storage requirements, air flow, etc. of any/all manufacturers. Contractor is responsible for the fitment of their proposed equipment within the space, room or area shown, and the resulting impacts to other construction or disciplines, Code compliance, etc.
4. Document each Submittal, Comparable Product or Substitution request with supporting data substantiating compliance of proposed product with

Basis-of-Design product.

5. Use the attached “Comparable Product Submittal Form” in addition to the requirements specified herein.
6. Comparable products will not be reviewed without completion of the attached form.

C. Descriptive Data:

1. Clearly indicate or state options, etc.:
   a. Manufacturer/cat. number.
   b. Manufacturer’s options.
   c. Accessories.
2. Manufacturer's specifications, data sheets.
3. Catalog cuts.
4. Dimensional drawings.
5. Drawing(s) to indicate muffler mounting location (in or on) enclosure).
6. Drawing(s) to indicate exhaust discharge direction and angle, pipe cap, etc.
7. Installation Instructions.
8. Wiring & connection diagrams. Indicate point of connections with other equipment or systems.
9. Capacity ratings of all components and accessories..
10. Manufacturer or vendor furnished load/starting calculations.
11. Clearly indicate the exact size or rating proposed.

D. Shop Drawings:

1. For all weatherproof and sound attenuating enclosures.
2. Factory drawings shall clearly show the mounting height to top of all breakers and controls (EPO, etc.) to verify maximum mounting height of 72” per NEC.

E. Product Test Reports:

1. Prototype test reports for proposed engine-generator assemblies.
2. Prototype testing shall have been performed on an identical generator unit, per ISO 8528, as configured for this project, including all accessories which can affect power output, including: water pump, fuel pump, radiator fan, alternator, etc.
3. Certified copies of manufacturer's design and routine factory tests required by the referenced standards.
4. Computer load acceptance, starting and running calculations, when requested, performed by the manufacturer’s authorized vendor.
5. Sound level test results of assembled engine-generator and sound attenuating enclosure. Demonstrate unenclosed sound levels versus enclosed levels. Provide calculations and test reports from the sound enclosure manufacturer or authorized vendor.

F. Factory Test Reports:

1. Perform in-factory testing of the actual generator to be shipped for this project.
2. Factory testing shall include:
   a. Full load running test at rated load for minimum of two (2) hours.
   b. Record all engine, alternator, fuel and alternator system parameters every 10 minutes.
   c. Cold start testing.

d. 100% load acceptance testing.
e. Safety Shutdown testing.

3. Factory test reports of the engine-generator assembly shall include the specific model and serial number of the unit.
4. Certified copies of manufacturer's design and factory tests required above or per the referenced standards.

G. Closeout Submittals: Submit in accordance with the General Conditions and Division 01 requirements, spec section “Common Work Results For Electrical”, and as follows:

1. Original load acceptance, starting and running load calculations.
2. All post-installation inspection checklists.
3. Installer’s pre-startup checklist.
4. Post installation load test results.
5. Preventative maintenance schedule for each unit.

1.5 QUALITY ASSURANCE

A. Manufacturer’s Requirements:

1. Coordinate the components of the system and their arrangements electrically and mechanically.
2. Manufacturer shall be experienced in manufacturing equipment of the types and capacities indicated that have a record of successful in-service performance for a minimum of 10 years.
3. Maintain, within 50 miles from site, a maintenance and service organization complete with parts inventory and repair facility. Service shall be available on a 24-hour basis.
4. Start up services and post installation tests, as specified.
5. Preventative Maintenance program as specified.

B. Single-Source Responsibility:

1. The complete performance of the assembled engine generator system, including all accessories shall be the sole responsibility of the generator supplier. It is the installer’s responsibility to ensure that all factory and field installed accessories and loose components used in the system, meet these specifications, and perform up to the stated and tested standards.
2. For exterior units, the manufacturer shall be responsible for the proper fit and performance of the weatherproof enclosure, exhaust system, including attachment hardware, support of mufflers, etc.

C. Certification and Compliance with Standards: Comply with the following specific Code and/or Standards requirements, and all other applicable Codes/standards of these agencies or publications.

1. Underwriters Laboratories (UL):
   a. UL2200 Listed Generator Assembly,
      1) Minimum working space requirements per UL2200.
      2) Wire bending space per UL2200 and NEC.
      3) Unit shall bear a UL2200 label.
   b. UL Listing of loose components, individually, where such standards exist.

2. National Electrical Code (NFPA 70)

a. NEC Article 700 Emergency Systems
b. NEC Article 702 Optional Standby Systems.

3. National Fire Protection Association (NFPA):
   a. NFPA 110 Emergency Power Systems

D. Installer Qualifications:

1. Has installed a minimum of five (5) generators of similar size and conditions.
2. Has installed a minimum of three (3) generators manufactured by the proposed manufacturer.

E. Installation Quality: In accordance with recognized trade organizations and standards.

1.	ANSI	American National Standards Institute
2.	ASME	American Society of Mechanical Engineers
3.	IEEE	Institute of Electrical and Electronics Engineers
4.	IEEE C2	National Electrical Safety Code
5.	NEC	National Electrical Code
6.	NECA	National Electrical Contractors Association “Standards of Installation”
7.	NEMA	National Electrical Manufacturer’s Association
8.	NETA	National Electrical Testing Association
9.	NFPA	National Fire Protection Association
10.	UL	Underwriter’s Laboratories

1.6 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Provide all transportation of unit(s) to site.
2. Provide for rigging needed for unloading, and setting into final position.

B. Storage and Protection:

1. Where unit is to be installed indoors, without enclosure, store in covered building or offsite to prevent exposure to weather, etc.

1.7 PROJECT CONDITIONS

A. The emergency power system level, classification and type shall meet the requirements of NFPA 110, as follows:

1.	Level:	1 (critical to Life safety)
2.	Classification:	Class 96 (96 hour operation)
3.	Type:	10 (power restored in 10 seconds)

B. The generator shall be capable of starting and operating the following loads in step increments under the specified parameters.

C. Step Load:

D. Performance Parameters:

1. Max loading 100% of rated generator capacity.
2. Max frequency dip 5%.
3. Starting voltage dip max 25%.
4. Max running voltage dip max 5%.

1.8 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Provide all transportation of unit(s), fuel tanks, enclosures and all components to site.
2. Provide for rigging needed for unloading generators and equipment.
3. Provide all rigging for setting equipment into final position.

B. Storage and Protection:

1. Store generators and all accessories in covered building or in factory weatherproof housing to prevent exposure to weather, etc. until building is weathertight and suitable for installation.
2. Maintain unit in factory shrink-wrap or similar protection until installed in final position.
3. After setting in final position, cover unit to protect from construction debris, fireproofing sprays, paint, etc. until ready for connections and startup.
4. Do not install control panels, PLC’s, or other electronic components or systems in buildings unless the room is stabilized with permanent or temporary HVAC and humidity control.

1.9 SEQUENCING

A. General Sequencing:

1. Coordinate generator installation with exterior grading, utilities and site construction.
2. Provide for sub-grade rough-ins.
3. Coordinate construction of concrete pads with final grading and underground utilities.

1.10 WARRANTY

A. Special Warranty: Extended product warranty over and above that required by General Conditions of this contract.

1. Covers complete standby power generation system:
   a. Engine.
   b. Alternator.
   c. Controls.
   d. Accessories.
   e. Transfer switches.
   f. Remote annunciation devices.
2. Warranty shall be by the manufacturer or authorized representative.
3. Warranty period of five (5) years or 1500 operating hours, whichever occurs first,

from initial startup.

4. Warranty includes all parts, labor, travel expenses, with no deductibles.
5. Installer shall complete and file all necessary documents to assure fulfillment of warranty requirements.
6. Deliver warranty documents to Owner in O & M manuals.

1.11 SYSTEM STARTUP

A. Manufacturer's Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of generator, associated components and accessories, and the pre-startup adjustment of all settings, components and accessories.

1.12 MAINTENANCE

A. Provide all materials and services of factory authorized service company to return at the end of twelve (12) and twenty four (24) months following completion of original contract. Preventative maintenance and testing of each new generator shall be performed at each visit, including, but not limited to the following items:

1. 4-hour full rated load test with test load bank, as specified previously.
2. Test and adjust all monitoring systems and annunciation devices.
3. Test and adjust all safety, starting and shutdown systems and devices, including all manual and automatic controls.
4. Test and adjust operation of all associated ATS's, battery chargers, fuel tanks, etc.
5. Replace all oil, air and coolant filters. Drain and replace associated fluids.
6. Adjust tension on all belts. Replace belts, as needed.
7. Check battery condition, specific gravity, electrolyte level. Add water as needed. Clean all terminals and connections. Apply anti-corrosion treatment.
8. Make adjustments to engine, fuel and starting systems to insure optimum starting and running efficiency.
9. Perform a fuel quality test on the fuel stored in the tank(s) in accordance with ASTM and the generator manufacturer’s recommendations. Advise owner of any conditions which require attention.

B. Provide a full report on each engine-generator at each adjustment/testing visit listing all maintenance procedures performed, all filter/fluid changes, adjustments, replacements, etc. Report shall also document the load test, indicating, voltages, amperes, oil pressure, alternator amps, engine temperature, battery charging current/voltage, etc. every 15 minutes. Also indicate any changes to the normal readings and at which point it/they occurred.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Available Manufacturers: Subject to compliance with requirements, provide a system by the named “Basis of Design” manufacturer, or a comparable product of one of the other following named manufacturers:

1. Kohler (Basis of Design)
2. Cummins
3. Caterpillar

2.2 RATINGS AND CONDITIONS

A. The following is based upon Kohler Model KD750.

1.	KW/kVA @ 0.8 PF:	750/938
2.	Voltage:	277/480V
3.	Phase:	3 φ
4.	Wire:	4 W

B. Engine Generator Specs:

1.	Fuel Consumption @ Full Load:	49.7 gal/hr
2.	Housed/Wet Weight:	68,266 lbs.
3.	Motor Starting kVA:	3,136 skVA
4.	Max. Voltage Dip for skVA	35 %

2.3 ENGINE

A. Engine shall be specifically matched to the generator to provide specified performance.

1. Full pressurized lubrication system, gear driven pump.
2. Vertical, multi-cylinder.
3. Manufacturer's nameplate identifying engine type, serial number, etc. for proper servicing.
4. Factory prototype testing, with test results available.
5. Engine shall not exceed greater than 10% lubricating oil consumption/loss over 100 hours of operation at any load (0-100%).
6. 4 cycle diesel (2 cycle engines are not permitted).
7. Designed for commercial grade ASTM D975 Number 2 diesel fuel.
8. Solid injection, full diesel type. The lubrication system shall be of the full pressure type.

B. Emissions: Provide an engine certified to meet EPA Non-road Source Emissions Standards, 40 CFR 89, Tier 3 or the appropriate Tier Schedules, based on engine kW and application. Contractor is responsible for providing proper Tier rating, coordination of manufacturing, shipping and startup dates. Owner will not accept incorrect Tier rating due to delays in installation, etc. which affect the required Tier rating.

C. Furnish engine with the following accessories:

1. Replaceable full flow oil filters.
2. Dry type air cleaners.
3. Fuel filter with replaceable element.
4. Battery charging alternator.
5. Isochronous governor to control engine speed. Frequency variation shall not exceed ± 0.25 % for constant loads from 0-100%. Cummins EFC or Woodward DSLC.
6. Heavy duty 12 or 24 volt starting system.
7. Gear driven starter motor. Cranking via gear drive.
8. Safety shutdown via control panel.
9. Water cooled oil cooler.
10. Coolant water pumps, centrifugal type, gear driven by engine, starting simultaneously with engine. System shall be designed for operation up to 125˚F without derating.

11. Engine mounted radiator, belt-driven fan, and thermostat.
12. No exposed moving parts. Guards installed on all rotating belts, blades, etc. per UL2200, “Standard for Safety for Stationary Engine Generator Assemblies.”
13. Jacket water heater, thermostatically controlled. Sized per manufacturer to maintain engine for cold start and load acceptance per NFPA 110. 4 KW (480V/60Hz/1φ), or as required by manufacturer. Provide isolation valves for servicing. Provide disconnect switch at generator.

2.4 GENERATOR

A. Generators shall be rated for continuous standby operation.

1. Heavy duty, single bearing, pre-lubricated type.
2. Temperature Rise: 125˚C.
3. Self-ventilating via direct drive blower.
4. Maximum speed not greater than 1800 rpm.
5. Flexible coupling of generator shaft to engine flywheel.
6. Self-regulating: Revolving field, 4-pole, brushless AC exciter with rotating rectifiers or static-exciter regulator assembly.
7. Stator twice impregnated with varnish, skewed to minimize heating and harmonics.
8. Excitor shall be full-wave rectified with silicon diodes mounted on rotor shaft. Manual reset circuit breaker shall protect field circuit.
9. Class "H" for 150˚C rise over a 40˚C ambient, as defined by NEMA Standard MG1-1.65, “Motors and Generators.”
10. 2/3 pitch. Sub-transient Reactance: Maximum of 12%
11. Re-connectable 12-lead bus bar system.

B. Solid state automatic voltage regulator with manual digital voltage adjustment.

1. Terminal voltage regulation of ±0.5% from 0-100% load.
2. Synchronous operation for immunity to SCR tracking.
3. Steady state output voltage maintained at ±0.5% of rated voltage from 0-100%
4. Output voltage recovery to ±1% of final voltage in less than 4 seconds after adding/removal 25 % load increments.

2.5 OUTPUT CIRCUIT BREAKERS

A. UL Listed output circuit breaker(s) on or at the generator.

1. Molded case circuit breaker, with electronic trip unit (ETU). See Section “Low Voltage Electrical Distribution” for trip unit specifications.
2. All generator-mounted circuit breakers shall be UL Service Entrance rated and shall bear a UL nameplate indicating this rating.
3. Breaker(s) shall have Form C aux contacts that indicate the position (open or closed) for each output breaker.
4. Rating as per drawings.
5. Each generator output breaker (serving as local generator disconnecting means) shall be capable of being locked in the OPEN position, compliant with NEC 445.18.
6. Breaker(s) shall meet requirements of Section “Low Voltage Electrical Distribution”.

2.6 CONTROLS

A. Integrated Control System: Control shall be via integrated generator set control system providing governing, voltage regulation, engine protection and operator interface functions. Major features include:

1. Integral Protective Relay providing a full range of alternator protection functions that are matched to the alternator provided.
2. Battery monitoring and testing features and smart starting control system.
3. Three phase sensing, full wave rectified voltage regulation system, with a PWM output for stable operation with all load types.
4. Standard PCC Net™ and optional Echelon LONWORKS® network interface.
5. Control suitable for operation in ambient temperature from -40 °C to +70 °C (-40 °F to +158 °F) and altitudes to 5000 meters (13,000 feet).
6. Prototype tested; UL, CSA, and CE compliant.

B. Operator/display panel:

1. Off/manual/auto mode switch
2. Manual run/stop switch
3. Panel lamp test switch
4. Emergency stop switch
5. Alpha-numeric display with pushbutton access for viewing engine and alternator data and providing setup, controls and adjustments
6. LED lamps indicating genset running, not in auto, common warning, common shutdown.
7. Configurable LED lamps (5).

C. Engine protection:

1. Over-speed shut down
2. Low oil pressure warning and shut down
3. High coolant temperature warning and shut down
4. High oil temperature warning (some models)
5. Low coolant level warning or shut down
6. Low coolant temperature warning
7. High and low battery voltage warning
8. Weak battery warning
9. Dead battery shut down
10. Fail to start (over-crank) shut down
11. Fail to crank shut down
12. Redundant start disconnect
13. Cranking lockout
14. Sensor failure indication.

D. Engine data:

1. DC voltage
2. Lube oil pressure
3. Coolant temperature
4. Lube oil temperature (some models)
5. Engine speed.

E. AC protection:

1. Over current and short-circuit shut down
2. Over current warning
3. Single and three phase fault regulation
4. Over and under voltage shut down
5. Over and under frequency shut down
6. Overload warning with alarm contact
7. Reverse power and reverse Var shut down
8. Excitation fault

F. Alternator data:

1. Line-to-line and line-to-neutral AC volts
2. Three phase AC current
3. Frequency
4. Total and individual phase power factor, kW and KVA

G. Other Data:

1. Genset model data
2. Start attempts, starts, running hours
3. kW hours (total and since reset)
4. Fault history
5. Load profile (hours less than 30% and hours more than 90% load)

H. Governing:

1. Digital electronic isochronous governor
2. Temperature dynamic governing
3. Smart idle speed mode
4. Glow plug control (some models)

I. Voltage regulation:

1. Digital PWM electronic voltage regulation
2. Three phase line-to-neutral sensing
3. Suitable for PMG or shunt excitation
4. Single and three phase fault regulation
5. Configurable torque matching

J. Control functions:

1. Data logging on faults
2. Time delay start and cooldown
3. Cycle cranking
4. Configurable customer inputs (4)
5. Configurable customer outputs (4)
6. Remote emergency stop

K. Control Panel:

1. Generator mounted, microprocessor based control panel.
2. Sealed front panel with gasketed doors.
3. Meets requirements of NFPA 99, “Health Care Facilities,” NFPA 110, “Emergency and Standby Power Systems” for Level 1 systems

4. Dead front type, NEMA 1 construction.
5. Separate customer interconnection/termination box, completely separate from control panel.
6. Vibration absorbing mountings.
7. Listed under UL 508, and UL2200.

L. Control Panel Functions:

1. Cycle cranking control.
2. Emergency stop switch/button.
3. Idle mode control.
4. Panel backlighting with switch.
5. Reset switch.
6. Run-Off-Auto switch.
7. Lamp test switch.
8. Audible alarm sounder.
9. "NOT IN AUTO" light signal at generator and remote panels whenever if out of "Automatic" position.
10. Automatic starting controls.
11. Auxiliary Run relays.
12. Common Failure Relays.
13. Spare pre-wired, Form C, dry contacts for remote monitoring, to indicate functions listed under Remote Monitoring Panel.

M. Standard Gauges, Meters & Warnings:

1. Ammeter (Analog or digital).
2. AC Voltmeter (Analog or digital).
3. Ammeter and voltmeter phase selector switches (L-L, L-N).
4. Voltage adjusting rheostat.
5. Current and potential transformers.
6. Frequency meter (Analog or digital).
7. DC Voltmeter
8. Engine oil pressure gauge.
9. Engine temperature gauge.
10. Running time meter.
11. Indicator lamps for the following:
    a. Over-crank
    b. Low Oil Pressure
    c. High Engine Temperature
    d. Over-speed
    e. Not In Auto
    f. System Ready
    g. Low Battery Voltage
    h. Battery Charger Fault
    i. Low Fuel
    j. Pre-Alarm - High Engine Temperature
    k. Pre-Alarm - Low Oil Pressure
    l. Low Water Temperature
    m. Auxiliary Alarm
    n. Auxiliary Pre-Alarm
    o. Liquid in rupture Tank
    p. Ground Fault Indication

N. Starting controls (Initiated via contact closure in ATS):

1. Starting control shall disconnect automatically after firing via speed sensing switch.
2. Lock out of start control for start failure or any safety shutdown. Manual reset required.
3. 3 start attempts of 15 seconds cranking each
4. 15 seconds between each attempt.
5. Total actual cranking time for the complete cranking cycle shall be 45 seconds during a 90 second interval.
6. After the engine has stopped, the cranking control shall reset.
7. OVER-CRANK signal light shall energize, start system shall lock-out and audio/visual alarm for failure.

O. Automatic Shutdown Controls:

1. Emergency Stop
2. Fail to Crank
3. High AC Voltage
4. High Coolant Temp
5. Low AC Voltage
6. Low Oil Pressure
7. Over-crank
8. Over-speed
9. Short Circuit
10. Under-frequency
11. Low Coolant Level

2.7 REMOTE MONITORING PANEL

A. Solid state remote monitoring panel with audible and LED visual alarm lamps to indicate the following functions:

1. Generator Running
2. Normal Power
3. Low Coolant Temperature (A)
4. High Coolant Temperature (A)
5. Pre-High Coolant Temp. (A)
6. Low Oil Pressure (A)
7. Pre-Low Oil Pressure (A)
8. Over-crank (A)
9. Over-speed (A)
10. Low Battery Voltage
11. Charger Fault (A)
12. Normal Battery Voltage
13. Low Engine Temp. (A)
14. Not in Auto Mode (A)
15. Emergency Stop (A)
16. Low Fuel (Main Tank) (A)
17. Liquid in Rupture Tank (Subbase Tank)

(A) indicates audio/visual alarm. Others are visual only.

B. Panel test button shall be provided to check all indicator lights. An audible alarm with

silence button shall warn user of generator trouble in addition to visual lamps.

2.8 BATTERY CHARGER

A. The battery charger shall be furnished as part of the engine/generator package from the manufacturer.

1. NEMA 1 enclosure.
2. Automatic equalize-charge & float modes.
3. DC volt and ammeter.
4. On-Off" control switch.
5. Fused AC input and DC output, with terminals for input and output connections.
6. DC output of 12 or 24 volts, as required.
7. Dry output contacts for AC input or DC output failure.
8. Relays for high and low DC voltage.
9. Inherently self-protected against shorts, overloads and reversed leads.
10. Fuses accessible from the front of the charger.

2.9 BATTERIES

A. For engine starting, provide heavy duty battery.

1. Lead calcium type batteries.
2. 12 or 24 volt as required by engine.
3. Batteries shipped dry.
4. CCA rated per engine manufacturer for 0˚F starting.
5. Non-metallic, corrosion resistant rack.
6. All cabling, connections and accessories.
7. Champion, Interstate, Exide, C&D Charter, or equal.

2.10 SUBBASE FUEL STORAGE TANK

A. Provide a sub base fuel storage tank under generator.

1. Listed per UL 142, “Steel Aboveground Tanks for Flammable and Combustible Liquids.”
2. Double wall tank, pressure tested to 5 psi on both inner and outer tank.
3. 5025 gallon capacity (96 hour runtime).
4. 12 gauge corrosion resistant steel tank.
5. 12 gauge top bottom and baffles, 7 gauge steel channel side supports.
6. All required fittings and connections, including, but not limited to, fuel supply and return, fuel level gauge, low fuel alarm, manual fill, vent, fuel in rupture tank alarm, etc. Pressure relief vent caps shall be supplied for both the inner and outer tank.
7. Normal vent and Emergency relief valve per NFPA 30, “Flammable and Combustible Liquids Code.”
8. Maximum height of 30 inches.
9. Manufacture shall insure that top of all circuit breakers and controls (ie EPO) shall be less than 72”, per NEC. Where higher mounting heights are required, manufacturer shall include permanent service platforms at all such devices.
10. Dimensions of tank shall be the same as the generator skid dimensions.
11. Finish shall be black, or shall match the color of Generator Enclosure.

2.11 WEATHERPROOF ENCLOSURE

A. The generator set shall be housed in a weatherproof outdoor housing as follows:

1. Welded and bolted, reinforced sheet steel.
2. Weatherproof enclosure, electrostatically painted with paint inside and out.
3. Inspection doors located for access to control equipment and maintenance points.
4. Doors with stainless steel hinges and key locking handles.
5. Expanded metal louvers for air intake and radiator.
6. Exhaust piping and silencer mounting sealed or flanged to insure a weatherproof installation.
7. Enclosure bolted to the generator set base.
8. Coolant and oil drain line extensions.
9. Two lifting eyes.
10. Sized to house the various control components herein specified. Mounting of components shall be accomplished in such a way that vibration effect is not an inherent problem.
11. Enclosure factory assembled/installed with generator and shipped as single unit.

B. Sound Attenuation:

1. Provide manufacturer's Level 2 custom designed enclosure to provide additional sound attenuation.
2. Construction shall include additional features listed below:
   a. Fully enclosed exhaust system.
   b. Non-hygroscopic internal sound absorbing materials.
   c. Vertical radiator discharge, as noted on drawings, with discharge plenum bird screen and drain.
   d. All access and inspection doors fully gasketed.
3. Expanded metal louvers or hoods shall be located for cooling air inlet.
4. Sound attenuation shall limit the sound to 75 db(A), measured at 7 meter distance from the enclosure, within the 500Hz - 2000Hz frequency range. Kohler Sound enclosure, or equal

2.12 FLUIDS

A. All fluids of type and rating per engine manufacturer:

1. Engine oil.
2. Ethylene Glycol Coolant with corrosion inhibitors.

2.13 REMOTE EMERGENCY SHUTDOWN SWITCH

A. Description: Remote Emergency Shutdown Switch for shut down of generator from each ATS location.

1. Mounted adjacent to ATS within each building's electrical room.
2. With all required wiring, contacts, and interface for interrupting generator "run" circuit to cause immediate engine/generator shutdown.
3. Yellow lexan housing, surface mounting.
4. Maintained position, red pushbutton (Turn to reset). PUSH label on center of button.
5. Label as EMERGENCY GENERATOR SHUTOFF
6. Safety Technology International, Inc. #SS2-2-3-1, or equal.

2.14 ALUMINUM SERVICE PLATFORM:

A. Provide a permanent, elevated service platform providing level access to all internal electrical and mechanical components for service, inspection, etc. Platform shall include permanent access stairs, railings, grating, supports, etc. Platform is not required on the radiator discharge end of the unit, unless the unit has serviceable equipment requiring access on that end.

B. Platform Construction and Features:

1. 42 inch wide service platform on sides and rear for accessing engine, alternator and internal components at level of the generator base rails. Exact extent of platform required shall be coordinated with generator manufacturer.
2. All aluminum frame, stairs, support rails and walkway surfaces.
3. Frame and staircase shall consist of 7-gauge Aluminum 5052-H32 material, formed construction, welded and bolted together.
4. Free-standing, adjustable legs to support the walkway. Stainless steel support foot pads to rest on concrete pad.
5. Walkway and stair tread shall be open tread aluminum, 5052H32, .125” thick. One piece metal plank-type. Cold form process. Large debossed holes surrounded by smaller embossed traction buttons.
6. 42”H handrails with center rails and 4”H toe board. Aluminum 6063-T52, 0.125” radius, 1.5” square tubing. Welded construction.
7. Integrated access stairs from concrete pad level to service platform, complying with all building codes. Step surfaces shall be open tread aluminum to match platform.
8. Aluminum support columns, with anchor bolts into generator’s concrete pad.
9. Tramont Walkway system with legs or approved equal.

2.15 CONCRETE EQUIPMENT PADS

A. As specified in civil engineering drawings and specs.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions: Examine the conditions under which the equipment shall be delivered, installed, and operated. Make all allowances required for operation and maintenance of the equipment, per Codes and manufacturer.

3.2 INSTALLATION

A. General Requirements:

1. Install all equipment, as indicated.
2. Maintain minimum working space at live parts according to manufacturer’s written instructions. Provide all required access space per NEC for controls, fuses and items requiring maintenance access.

B. Rough-in:

1. Rough-in all underslab, below grade or below roof conduits, ducts, etc. prior to setting generator in place.

2. Coordinate exact stub-ups with proposed manufacturer's equipment installation drawings. All conduit shall be within the generator footprint.
3. Rough-in for all required circuits, controls, connections, etc. as required by proposed equipment, even if not explicitly indicated on plans.

C. Generator Installation On Exterior Concrete Equipment Pad:

1. Provide concrete foundation/equipment pad or housekeeping pad, per "Common Work Results For Electrical."
2. Construct concrete pads such that pad is a minimum of 6 inches above surrounding grade.
3. Coordinate conduit and fuel line stub-ups within generator frame and/or sub-base tank. No conduit is permitted outside of generator footprint.
4. Install generator so as to direct radiator airflow away from buildings, fences, walls, etc. Maintain clear airflow for a minimum of 10 LF, or as per manufacturer.
5. Install exhaust discharge parallel to ground in same direction as radiator discharge, or vertically upward, per drawings.
6. Ensure that all service access doors can be fully opened for access.
7. Maintain 42" minimum width around entire generator set for maintenance access.
8. Seal all penetrations for conduit, piping, exhaust, etc. to maintain weatherproof and/or sound attenuating properties.
9. Where generator is mounted atop a sub-base fuel tank, securely anchor the subbase tank to concrete pad.
10. Provide ribbed rubber sound pads between tank and concrete pad.
11. Mount generator assembly steel skid on a minimum of four spring type vibration isolators (where required by specifications) between skid and subbase fuel tank.
12. Adjust internal isolator leveling bolts for level installation.
13. Where gensets use internal vibration isolation, securely bolt the genset skid directly to the subbase tank.
14. Provide steel service platform, stairs and railings, as indicated.

D. Generator Fuel Line Connections:

1. Provide flexible stainless steel fuel lines in within first 18" between engine and all rigid fuel supply and/or return line(s), sub-base tanks, skid mounted day-tanks, or connections to rigid gas piping system.

E. Generator Sub-base Tank:

1. Securely attach sub-base tank to the concrete slab.
2. Provide all required fittings and connections, including, but not limited to, fuel supply and return, fuel level gauge, low fuel alarm, manual fill, vent, fuel in rupture tank alarm, etc.
3. Provide pressure relief vent caps for both the inner and outer tank.
4. Connect all alarms to the control panel and remote annunciator, where applicable.
5. Coordinate tank installation with electrical and plumbing connections.
6. Make provisions for electrical stub-up access after tank installation.
7. Vent all tank(s) per NFPA 30, "Flammable and Combustible Liquids Code."

F. Fluids: Provide all fluids of type and rating per engine manufacturer, for initial starting, testing and final delivery to Owner including:

1. Engine oil.

2. Completely fill entire system including radiator and all piping with coolant and softened water in 50:50 ratio. Add corrosion inhibitor.
3. ASTM D975 Number 2 Diesel Fuel:
4. Provide as required for startup and testing.
5. Completely fill storage tanks, sub-base tank, and/or all daytanks prior to delivery to owner, after all startup and testing.

G. Electrical Accessories:

1. Provide local disconnecting means for all generator accessories for servicing, to comply with NEC:
   a. Battery Chargers - provide toggle switch.
   b. Jacket Heaters - provide non-fused safety switch.

H. Starting Batteries:

1. Fill dry battery cells with distilled water per manufacturer's instructions.
2. Provide hold-downs for each battery cell to prevent movement.
3. Apply spray-on corrosion inhibitor with red dye to all battery terminals.

I. Remote Equipment: Install all remote equipment, as specified, indicated on contract drawings, or required for proper operation of generator system. Provide all raceways, wiring, connections, testing of remote equipment:

1. Remote Monitoring Panels.
2. Emergency Generator Stop Buttons.
3. Connections to sensors and other equipment displayed and/or monitored by the generator control system and status panel.
   a. Fuel leak detection sensors.
   b. High/low fuel level sensors.
   c. Battery charger failure.
4. Connections to automatic transfer switch(es) connected to the generator control system.
   a. Engine start/stop controls.

3.3 CONSTRUCTION

A. Interface with Other Work:

1. Provide connections between generator and other work of this contract:
   a. Auto transfer switch(es).
   b. Panelboards, switchboards, etc.
   c. Fire alarm system.

B. Sequences of Operation: Where multiple automatic transfer switches are coupled to a single generator, the starting control system shall be such that Engine Start contacts at any transfer switch will start the engine. Engines shall not shut down until all associated transfer switches have transferred back to normal source and all cool-down time delays have expired.

3.4 GROUNDING & BONDING

A. Connections: Ground generators, frame and enclosures per NEC Article 250, "Grounding" and as specified in Section "Grounding & Bonding for Electrical Systems."

B. Ground generator system as follows:

1. Connect alternator equipment ground lug to generator frame and housing.
2. Provide grounding electrode conductor to bond generator ground bus to the building ground system through the ATS ground lug.
3. Driven ground rod at the generator location for grounding frame and housing.
4. For rooftop units, bond generator steel skid frame to the structural steel on roof via #4/0AWG copper conductor and exothermic welds.
5. All sizes shall be as per NEC or as indicated on drawings, whichever is larger.

C. Provide a separately derived system:

1. Ground the generator neutral bus to the ground lug on the generator frame.
2. The size of the neutral grounding conductor (jumper) shall equal the size of the neutral conductor indicated on the plans on the load side of the circuit breaker.

3.5 REPAIR/RESTORATION

A. Restore all finishes, equipment, surfaces and/or grade to original condition, where affected by the work of this section.

3.6 FIELD QUALITY CONTROL

A. Independent Testing Agency: Provide services of an independent electrical testing agency, according to the requirements of Section "Quality Control" to perform tests on generator installations.

B. Test Objectives: To ensure generator installation complies with Contract Documents, is operational within industry and manufacturer's tolerances, is adjusted to specific project parameters, and is suitable for energizing.

C. Site Tests:

1. Schedule tests and provide notification at least one week in advance of test commencement.
2. Pre-Startup Testing: After completing system installation, perform the following preparations for tests:
   a. Make insulation-resistance tests for generator, output breaker(s).
   b. Make continuity tests of windings and remote alarm circuits.
   c. Verify(measure) frame and equipment ground resistance.
   d. Verify (measure) alternator neutral bonding to, or isolation from ground, as applicable.
   e. Check torque on cable terminations.
   f. Provide a set of Contract Drawings to the testing agency.
   g. Provide manufacturer's installation and testing instructions to the testing agency.
   h. Provide complete shop drawing data on all equipment.
3. Start-Up Services:
   a. The complete installation shall be initially started and checked for operational compliance by factory trained manufacturer's representative(s).
   b. Inspect accessible components for cleanliness, mechanical, and electrical integrity, for presence of damage or deterioration, and to

ensure removal of temporary shipping bracing. Do not proceed with tests until deficiencies are corrected.

c. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, where not available, those of Standards 486A, “Wire Connectors and Soldering Lugs for Use with Copper Conductors.”

d. All settings, as specified in this section, shall be properly set and verified by start-up personnel.

e. Provide a written start-up and testing checklist, which verifies all settings and features are properly set and functioning. Written report shall indicate final setting of all adjustable features.

4. Generator Tests: After installing generator, perform the following tests, at a minimum:

a. Phase rotation. Matched to load requirements.

b. All protective and shutdown features tested.

c. Complete integrated test of generator and automatic transfer switch and control.

d. Specified pickup, dropout, transfer, retransfer, engine start and cool down, and exercise timer settings.

e. Operation of transfer and retransfer operation, including failure of emergency source.

f. Operation of auxiliary contacts and devices.

g. Operation of all gauges, displays and control equipment.

h. Ground-Fault Systems: Perform inspections and tests stated in NETA ATS, Section 7.14.

D. Remove and replace malfunctioning components with new, and retest.

E. Test Failures: Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest.

F. Load Testing:

1. Schedule and perform a post-installation load test to demonstrate the load capacity of the unit. Installer shall be present during the start-up and testing. Notify Owner and Architect at least one week in advance of start up/test date.

2. A resistive load bank shall be used to test the generator.

a. Load generator to nameplate rating.

b. Maintain records for duration of test. Record:

c. Time of day.

d. Ambient air temperature

e. Coolant temperature.

f. Cranking time to start.

g. Output voltage, frequency, current.

h. Oil pressure.

i. Battery charger rate at 5 minute intervals for the first 15 minutes and at 15 minute intervals thereafter.

j. Load test shall be run as follows, recording load changes and the result on voltage and frequency.

k. 25% rated load for 20 minutes

l. 50% rated load for 20 minutes

m. 75% rated load for 20 minutes

n. 100% rated load for 3 hours

3. Following running load test, allow generator to run unloaded for a cool down

period of 5 minutes.

4. After shutdown and another 5 minute period (not running), apply full rated load (nameplate KW). Apply load in one increment of 100% full load pick-up immediately upon reaching rated RPM. Test shall be run at full load for 30 minutes. Allow all proper cool down periods.

3.7 IDENTIFICATION

A. Provide permanent warning signs on generator housings and on fenced yards containing generators and associated equipment. Warning signs shall be as specified in section “Common Work Results for Electrical”.

B. Provide Red identification plate(s) with white engraved letters on the main service equipment to identify the type and location of emergency generator, per NEC articles 700, 701, 702, as applicable.

C. Where the generator disconnecting means is located within the unit housing, provide a red identification plate with white engraved letters on the housing access door to indicate the location of the disconnecting means. Label shall state “GENERATOR DISCONNECT LOCATED BEHIND THIS DOOR”, per NEC Articles 445.18, as applicable.

D. Provide red identification plate with white engraved letters at each remote Emergency Generation Shutdown switch per NEC Articles 445.19, as applicable. Where more than one generator exists, the label shall also identify the specific generator.

3.8 ADJUSTING

A. General:

1. Set all field adjustable parameters to those as specified.

3.9 CLEANING

A. Inspect interior and exterior of installed generators and enclosures. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.10 DEMONSTRATION

A. Training: Arrange and pay for the services of a factory-authorized service representative to demonstrate generator and accessories and train Owner's staff. Include a minimum of 8 hours of training in operation and maintenance. Provide both classroom training and hands-on equipment operation covering the following:

1. Safety precautions.
2. Features and construction of project equipment and accessories.
3. Routine inspection, test and maintenance procedures.
4. Routine cleaning.
5. Changing of filters, fluids, etc.
6. Features, operation, and maintenance of unit and protective devices.
7. Interpretation of readings of indicating and alarm devices.
8. Coordination with transfer switch(es).
9. Ground fault protection systems.

B. Schedule training with at least 7 days' advance notice.

3.11 COMMISSIONING

A. Per 2023 NEC 700.3(A) and 701.3(A), provide for commissioning of the Emergency Power Systems, referring to and in compliance with the following:
   1. NECA 90 “Standard for Commissioning Building Electrical Systems.”
   2. Division 1 spec section “Commissioning.”
   3. Division 26 spec section “Commissioning of Electrical.”
   4. Per NEC, the AHJ shall be present to witness the commissioning and functional testing of the systems.

B. This project includes Commissioning of selected systems and components. Provide for commissioning of the generator system(s) and components, as required per Section “Commissioning of Electrical Systems”, and the Commissioning Plan.

END OF SECTION

SECTION 26 36 00

TRANSFER SWITCHES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Section Includes:

1. Automatic transfer switches.
2. Bypass isolation switches.

B. Related Sections:

1. Section “Common Work Results for Electrical” for concrete pads, labeling, and other general requirements.
2. Section “Grounding & Bonding for Electrical Systems” for grounding and bonding requirements.
3. Section “Low Voltage Power Conductors and Cables” for conductors and attachments.
4. Section “Raceways and Boxes for Electrical Systems” for conduit and raceway connections.
5. Section “Packaged Generator Assemblies” for coordination with generators for interface and control requirements, and grounding/bonding of alternator neutrals.
6. Section “Commissioning of Electrical Systems” for specific commissioning and functional performance testing requirements.

C. Submittal Requirements of this section:

1. Automatic transfer switches.
2. Bypass isolation switches.
3. Remote shutoff switches.

D. Descriptive Data:

1. Clearly indicate or state options, etc.:
   a. Manufacturer/catalogue number.
   b. Manufacturer’s options.
   c. Accessories.
2. Information on all adjustable features including adjustment range and manufacturers’ settings.
3. Manufacturer's specifications, data sheets.
4. Catalog cuts.
5. Dimensional drawings.
6. Installation Instructions.
7. Wiring & connection diagrams. Indicate point of connections with other equipment or systems.

8. Capacity ratings.
9. Clearly indicate the exact size or rating proposed.

E. Product Test Reports:

1. Prototype test reports for proposed switches.
2. Certified copies of manufacturer's design and routine factory tests required by the referenced standards.

F. Closeout Submittals: Submit in accordance with the General Conditions and Division 10 requirements, Section “Common Work Results For Electrical”, and as follows:

1. All post-installation inspection checklists.
2. Installer’s pre-startup checklist.
3. Preventative maintenance and testing schedule for each unit.

1.3 REFERENCES

A. IEEE:

1.	IEEE 241	IEEE Recommended Practice for Electric Power Systems in Commercial Buildings
2.	IEEE 446	IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications

B. National Electrical Code (NEC):

1.	NEC 700	Emergency Systems
2.	NEC 702	Optional Standby Systems

C. National Fire Protection Association (NFPA):

1.	NFPA 70	National Electrical Code
2.	NFPA 110	Emergency And Standby Power Systems

D. Underwriters Laboratory (UL):

1.	UL 508	Industrial Control Equipment
2.	UL 1008	Standard for Transfer Switch Equipment, 7th Edition (or latest)

1.4 SUBMITTALS

A. Submittal Requirements of this section:

1. Automatic Transfer Switches.

B. Product data: Include dimensions, construction, materials, performance data, etc.

C. Provide submittal data for each product type.

1. To verify specifications have been met/exceeded.
2. Independent laboratory test data where requested.
3. Clearly indicate or state all options, etc.:

D. Submit the following for each transfer switch unit:

1. Manufacturer/cat. number.
2. Listed and labeled per UL 1008.
3. System voltage & configuration.
4. Withstand and Close Ratings.
5. Indicate all options and/or accessories.
6. Indicate field adjustable settings, setpoint ranges, and factory setpoints.
7. Bus materials and ratings.
8. 1-line diagram showing all components, connections, accessories, etc.
9. Additional information to show compliance with specifications or drawings.

E. Product Test Reports: Certified copies of manufacturer's design and routine factory tests required by the referenced standards.

F. Closeout Submittals: Submit in accordance with the General Conditions and Division 01 requirements, Section “Common Work Results For Electrical, and as follows:

1. All post-installation inspection checklists.
2. Installer’s pre-startup checklist.
3. Final setpoint of all adjustable parameters.
4. Post installation load test results.
5. Preventative maintenance schedule for each unit.

1.5 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms “Listed and Labeled”: As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.
3. Where equipment consists of multiple components, the entire assembly or product shall be UL Listed and Labeled or Labeled by a testing organization acceptable to the Authority Having Jurisdiction per the NEC.

B. Manufacturer’s Requirements:

1. Coordinate the components of the system and their arrangements electrically and mechanically.
2. Manufacturer shall be experienced in manufacturing equipment of the types and capacities indicated that have a record of successful in-service performance for a minimum of 10 years.
3. Maintain, within 50 miles from site, a maintenance and service organization complete with parts inventory and repair facility. Service shall be available on a 24-hour basis.
4. Start up services and post installation tests, as specified.
5. Preventative Maintenance program as specified.

C. Installer Qualifications:

1. Has installed a minimum of five (5) switches of similar size and conditions.
2. Has installed a minimum of three (3) switches manufactured by the proposed

manufacturer.

D. Installation Quality: In accordance with recognized trade organizations and standards.

1.	ANSI	American National Standards Institute
2.	ASME	American Society of Mechanical Engineers
3.	ASTM	American Society for Testing and Materials
4.	IEEE	Institute of Electrical and Electronics Engineers
5.	IEEE C2	National Electrical Safety Code
6.	NEC	National Electrical Code
7.	NECA	National Electrical Contractor's Association "Standards of Installation".
8.	NEMA	National Equipment Manufacturers Association
9.	NESC	National Electrical Safety Code
10.	NETA	National Electrical Testing Association
11.	NFPA	National Fire Protection Association
12.	UL	Underwriter's Laboratories

1.6 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Provide all transportation of equipment to site.
2. Provide for rigging needed for unloading and setting large switches into final position.

B. Storage and Protection:

1. Store in covered building or offsite to prevent exposure to weather, etc. until building is protected from the elements.
2. Apply temporary heat according to manufacturer's recommendations within enclosures of large each switches, throughout periods during which equipment is not energized and is not under normal control of temperature and humidity.

1.7 SEQUENCING

A. General Sequencing:

1. Coordinate switch installation with exterior and/or interior construction.
2. Provide for sub-grade or subslab roughins.
3. Coordinate all power and control conduit locations, roughins and destinations with switch location.

1.8 WARRANTY

A. Special Warranty: Extended product warranty over and above that required by General Conditions of this contract.

1. Covers complete automatic transfer system:
   a. Auto-transfer switches.
   b. Controls.
   c. Accessories.
   d. Remote annunciation devices.
2. Warranty shall be by the manufacturer or authorized representative.

3. Warranty period of five (5) years or 1500 operating hours, whichever occurs first, from initial start-up.
4. Warranty includes all parts, labor, and travel expenses, with no deductibles.
5. Installer shall complete and file all necessary documents to assure fulfillment of warranty requirements.
6. Deliver warranty documents to Owner in O & M manuals.

1.9 SYSTEM STARTUP

A. Manufacturer's Services: Provide services of a factory-authorized service representative to supervise the field connections with normal and emergency sources, associated components and accessories, and the pretesting and adjustment of all settings, components and accessories.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Available Manufacturers: Subject to compliance with requirements, provide a system by the named “Basis of Design” manufacturer, or a comparable product of one of the other following named manufacturers:

B. Automatic Transfer Switch sets shall be manufactured by one of the following:

1. Kohler (basis of design)
2. Automatic Switch Company (ASCO)
3. Cummins
4. Caterpillar

2.2 AUTOMATIC TRANSFER SWITCHES

A. General Construction:

1. NEMA 1 enclosure, key lockable.
2. Microprocessor control panel.
3. Voltage and Ampere ratings as indicated.
4. 4-pole switch with switched neutral for use in a separately derived system and on Ground Fault Protection equipped systems.
5. Listed per UL 1008. All accessories for the transfer switch (and/or control panel) shall be UL recognized.
6. 100% continuous current rated.
7. Comply with IEEE 241-1990 and IEEE 446-1995.
8. Comply with NEC Articles 700 and 701.
9. Withstand and Close (WCR) ratings to per UL1008.
10. DPDT Engine start contacts, 10 amps, 32 VDC.
11. Silver or tin plated copper bus, and UL Listed lugs.
12. Equipment ground lug.
13. Flash memory storage of all programmed settings.
14. Integral battery backup of real-time clock settings.

B. Contacts and Operation:

1. Spring-loaded, over-center main contacts, silver alloy plated.
2. Electrically operated (momentarily energized) from source being transferred to.

3. Single linear motor operator. Capacitors, fuses, or thermal protection in the main operator control circuit are prohibited.
4. Mechanically held contacts.
5. Mechanical and electrical interlocks to prevent paralleling sources.
6. Contact pressure shall be maintained and shall be unaffected by momentary outages.
7. All stationary and moveable contacts shall be replaceable without removing power conductors, lugs or bus bars.
8. Switches rated $\geq$ 800 amps shall have segmented, blow-on construction for high withstand and close-on capability and protected by separate arcing contacts.
9. Use of molded case circuit breakers or contactors is not acceptable.

C. Adjustable Settings:

	Range	Setting
1. Under-Voltage Sensing (3-phase normal, 1-phase emergency):		
Pickup (% of nominal):	85%-100%	95%
Dropout (% of pickup):	70%- 98%	95%
Dropout Time Delay:	0.1-1.0 sec	0.5 sec
2. Over-Voltage Sensing (3-phase normal, 1-phase emergency):		
Pickup (% of nominal):	105%-135%	115%
Dropout (% of pickup):	95%- 99%	95%
Dropout Time Delay:	0.5-120 sec	30 sec
3. Over/Under Frequency sensing:		
Pickup (% of nominal):	+5 - +20%	+5%
Dropout: (% beyond pickup):	+1%	+1%
Dropout Time Delay:	0.1-15 sec	5

D. Accessories:

1. LED Status pilot lights.
   a. Green = normal source available.
   b. Red = emergency source available.
   c. Green = connected to normal source.
   d. Red = connected to emergency source
2. Momentary test switch to simulate normal source failure.
3. Control panel disconnect plug.
4. In-Phase monitor:
   a. Transfer/retransfer between live sources only when the two sources are approaching synchronism and the two sources are within 15 electrical degrees maximum.
   b. Function over a frequency difference range of up to $\pm$ 2.0 Hz.
   c. Maximum operating transfer time of 1/6 second.
   d. If the voltage of the load carrying source drops below 75%, the in-phase function shall be automatically bypassed.
   e. Monitor shall not require interconnection with the generator controls, or active control of the governor.
5. Engine Start Delay (0 – 15 sec, set at 3 sec).
6. Retransfer Emergency to Normal Time Delay (0-30 min, set at 5 min).
7. Engine cool down timer, no load (0-30 min, set at 5 min).
8. Transfer to Emergency Time Delay (0- 120 sec, set at 1 sec).
9. Auxiliary contacts:
   a. 1 closed for normal.
   b. 1 closed for emergency.

c. Rated 10 amps, 250VAC, 60 Hz.
d. Provide in addition to any specific function contacts specified elsewhere.
e. All contacts shall be factory wired to a terminal strip.

10. Elevator –pre signal relay (0-60 seconds) to prevent interruption of power during elevator operation.

E. The automatic transfer and bypass isolation switch shall work to provide a means of manually bypassing the ATS for testing or maintenance of the ATS or for manually transferring load from normal to emergency and vice-versa without interruptions to load.

1. 1/16 second transfer operation by ATS or bypass switch, regardless of speed of the manual bypass switch handle.
2. A 3-position bypass handle shall be provided for the manual bypass switch with positions as follows: Bypass To Normal, Automatic, Bypass To Emergency. Provisions for padlocking in Bypass modes shall be provided.
3. The ATS shall be equipped with a 3-position isolation handle with positions: Closed, Test, Open. The Isolation handle shall be interlocked to prevent operation unless the Bypass handle is in the Bypass position. The Test position shall disconnect load from ATS, but sources shall remain connected for testing purposes.
4. Permanent means of identifying handles and positions shall be provided through a mimic bus on enclosure front or by permanently attached name plates, subject to approval.
5. Operation shall be dead front and shall be capable of being performed by one person with a maximum of two handle operations. Opening at the switchboard door to operate Isolation or Bypass handles will not be acceptable. No other handles or controls, besides the Isolation and Bypass handles, shall be required to switch services from Automatic to Bypass and Test positions and back.
6. Bypass contactor shall be housed in a separate, barriered compartment from the main contactor.

F. Exercise timer.

1. Solid state, with battery reserve power supply.
2. With Load/No-Load selector switch (set for No-Load).
3. Adjustable for: Time of Day, Day of week, Week of month, and test duration.
4. Set for 30 minutes every 7 days, unless instructed otherwise.

G. All delays and functions shall be field adjustable and shall maintain accuracy within □1% of set values of frequency, □2% for voltages, and □10% on time delays. Control panels for each switch shall be solid state and shall include an isolating disconnect plug. Controls switches and related devices shall operate over a temperature range of -20°C to +50°C.

H. Withstand and Closing Ratings (WCR):

1. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATSs which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.
2. WCR's shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans, and those proposed by the contractor for this project.

ATS Rating	Voltage	WCR (Amps) w/Max MCCB Rating Specific MCCB	Amps @ WCR
150-260 A	480 V	30,000	400
1200 A	480 V	85,000	1600

3-Cycle Ratings:

ATS Rating	Volt (Max)	WCR (Amps) w/Max MCCB Rating Specific MCCB	Amps @ WCR
300-600 A	600 V	25,000	1200
800-1000 A	600 V	35,000	1400
1200 A(Open)	480 V	50,000	1600

I. Manual Operation: ATS shall have permanently attached, insulated handle for manual operation. Handles shall manually operate the same contacts used for automatic operation.

J. Open Transition Transfer Switches: Kohler KSS or KCS Series, Cummins OPTC, Generac GTS Series, or comparable product by a previously named manufacturer.

K. Bypass Isolation Transfer Switches: Kohler KBS Series (Open transition) or KBP Series (Programmed/Delayed Transition), Cummins BTPC Series, ASCO 962 Bypass Isolation Transfer Switch, or comparable product by a previously named manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions: Examine the conditions under which the equipment shall be delivered, installed, and operated. Make all allowances required for operation and maintenance of the equipment, per Codes and manufacturer.

3.2 INSTALLATION

A. General Requirements:

1. Install all equipment, as indicated.
2. Maintain minimum working space at live parts according to manufacturer’s written instructions and NEC.
3. Provide all required access space per NEC for controls, fuses and items requiring maintenance access.
4. Maintain isolation of load, normal and emergency conductors, except within the switch enclosure(s).
5. Install freestanding equipment on concrete housekeeping pads as per Section “Common Work Results For Electrical”, and as indicated.
6. On switches on exterior, below-grade walls, maintain a minimum of 1 inch of clearance between wall and rear of switch enclosure.

B. Rough-in:

1. Rough-in all underslab or below grade conduits, ducts, etc. prior to setting switches or other equipment in place.
2. Coordinate exact stubups with proposed manufacturer’s equipment installation drawings and the work of other trades in this contract.
3. Roughin for all required circuits, controls, connections, etc. as required by

proposed equipment, even if not explicitly indicated on plans.

4. Make minor adjustments to locations so as to maintain required front working clearances and clearance above and below per NEC.

C. Remote Equipment: Install all remote equipment, as specified, indicated on contract drawings, or required for proper operation of transfer switch system. Provide all raceways, wiring, connections, testing of remote equipment:

1. Connections to engine/generator(s) for engine start/stop controls.

3.3 CONSTRUCTION

A. Interface with Other Work:

1. Provide connections between transfer switch(es) and other work of this contract:
   a. Building electrical system.
   b. Emergency generator.
   c.

B. Interface with Other Work:

1. Provide connections between transfer switch(es) and other work of this contract:
   a. Building electrical system.
   b. Emergency generator.

C. Sequences of Operation: Where multiple automatic transfer switches are coupled to a single generator, the starting control system shall be such that Engine Start contacts at any transfer switch will start the engine. Engines shall not shut down until all associated transfer switches have transferred back to normal source and all cool-down time delays have expired.

D. Grounding: Ground ATS cabinets, all metallic service and distribution equipment frames and enclosures per NEC and as specified in Section “Grounding & Bonding For Electrical Systems”. Ground transfer switch system as follows:

1. Connect transfer switch ground lug to enclosure and to normal, emergency and load circuit equipment grounding conductors.
2. All sizes shall be as per NEC or as indicated on drawings, whichever is larger.
3. Maintain isolation of all grounded equipment conductors (neutrals) within the transfer switch enclosure from ground.

E. Connections: Tighten joints, connectors and terminals, including screws and bolts, in accordance with manufacturer’s published torque tightening values for connectors and bolts. Where manufacturer’s torque requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A, “Wire Connectors and Soldering Lugs for Use with Copper Conductors” and 486B.”

3.4 REPAIR/RESTORATION

A. Restore all finishes, equipment, surfaces and/or grade to original condition, where affected by the work of this section.

3.5 FIELD QUALITY CONTROL

A. General:

1. Perform inspections and testing to ensure installation complies with Contract Documents, is operational within industry and manufacturer's tolerances, is adjusted to specific project parameters, and is suitable for energizing.
2. Test all system functions, operations, and protective features according to manufacturer's written instructions.
3. Acceptance Testing: Provide for acceptance testing of electrical equipment specified in this section, as follows, and as required in Section "Common Work Results For Electrical."
4. Schedule tests and provide notification at least one week in advance of test commencement.
5. Provide a set of Contract Drawings to the testing agency.
6. Provide manufacturer's installation and testing instructions to the testing agency.
7. Provide complete shop drawing data on all equipment.
8. Provide written results of all tests. Include date, equipment ID, name of testing company and technician, and results of each individual test. Provide pass/fail indication for each test.

B. Pre-Testing Inspections:

1. Inspect accessible components for cleanliness, mechanical, and electrical integrity, for presence of damage or deterioration, and to ensure removal of temporary shipping bracing. Do not proceed with tests until deficiencies are corrected.
2. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, where not available, those of UL Standards 486A and 486B.
3. Inspect to confirm proper isolation of neutrals to ground.
4. All settings, as specified in this section, shall be properly set and verified prior to equipment testing.

C. Acceptance Testing:

1. Transfer Switch Tests: After installing equipment, perform the following tests, at a minimum:
   a. Perform inspections and tests stated in NETA ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems,"
   b. Tests shall be performed with switch in both normal and emergency positions.
   c. Set & calibrate all settings per specifications.
   d. Perform insulation-resistance tests for all buses and contactor assemblies.
   e. Perform insulation resistance tests, phase-phase and phase-ground.
   f. Perform continuity tests of all grounds, and bonded components.
   g. Perform overpotential tests per ANSI 37.20c.
   h. Phase rotation. Matched to load requirements.
   i. All protective and shutdown features tested.
   j. Specified pickup, dropout, transfer, retransfer, engine start and cool down, and exercise timer settings.
   k. Operation of transfer and retransfer operation, including failure of emergency source.
   l. Operation of all warning and safety shutdown features, annunciation panels and lights, by simulating failure of each component.
   m. Operation of isolation bypass switch, where so equipped, in normal and emergency source modes.

n. Operation of auxiliary contacts and devices.
o. Operation of all gauges, pilot lights, test switches, and other control equipment.

D. Test Failures: Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest. Remove and replace malfunctioning components with new, and retest.

E. Test Labeling: Upon satisfactory completion of tests for each transformer, attach a dated and signed "Satisfactory Test" label to the unit.

F. Manufacturer’s Field Services:

1. Provide on-site, post installation by factory-trained manufacturer's representative(s).
2. Assist installer and verify that all adjustable parameters are set, as specified in this section.
3. Provide a written start-up and testing checklist, which verifies all settings and features are properly set and functioning.

3.6 ADJUSTING

A. General:

1. Set all adjustable parameters to those as specified.
2. Provide written report, included in O&M Manuals, to indicate final setting of all adjustable features.

3.7 IDENTIFICATION

A. Identify all distribution system components and wiring in accordance with Section “Common Work Results For Electrical”.

1. Provide engraved nameplate for each transfer switch, which identifies the equipment per project nomenclature, and load served. Label as follows:

ATS-LS
LIFE SAFETY LOADS

ATS-OE
BLDG EMERGENCY LOADS

3.8 CLEANING

A. Inspect interior and exterior of installed switches. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.9 DEMONSTRATION

A. Training: Arrange and pay for the services of a factory-authorized service representative to demonstrate transfer switch operation and accessories to Owner's staff. Include discussion on all conditions of operation and maintenance. Provide hands-on equipment operation using the actual installed switch(es), covering the following:

1. Safety precautions.

2. Features and construction of project equipment and accessories.
3. Routine inspection, test and maintenance procedures.
4. Routine cleaning.
5. Adjustable parameters, how and why to adjust.
6. Features, operation, and maintenance of unit and protective devices.
7. Manual switch operation.
8. Setting of exercise timer and load/no load selection.
9. Use of test switch to test switch and generator operation.
10. Coordination with generators.

B. Schedule training with at least 7 days' advance notice, and in conjunction with generator discussions, where applicable.

3.10 COMMISSIONING

A. Per 2023 NEC 700.3(A) and 701.3(A), provide for commissioning of the Emergency Power Systems, referring to and in compliance with the following:
1. NECA 90 “Standard for Commissioning Building Electrical Systems.”
2. Division 1 spec section “Commissioning.”
3. Division 26 spec section “Commissioning of Electrical.”
4. Per NEC, the AHJ shall be present to witness the commissioning and functional testing of the systems.

B. This project includes Commissioning of selected systems and components. Provide for commissioning of the transfer switch(es), as required per Section “Commissioning of Electrical Systems”, and the Commissioning Plan.

END OF SECTION

SECTION 26 41 13

LIGHTNING PROTECTION FOR STRUCTURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Provide a complete lightning protection system for the building(s) and/or structure(s) included in this project. The system(s) shall comply with the latest specifications and standards of NFPA 780, “Standard for the Installation of Lightning Protection Systems,” 2017.

B. Section Includes:

1. System design.
2. Air terminals.
3. Roof conductors.
4. Down conductors.
5. Counterpoise.
6. Ground connections.
7. Ground rods.
8. Connections, clamps and all misc. hardware.

C. Related Sections:

1. Section “Common Work Results For Electrical.”
2. Section “Grounding & Bonding For Electrical Systems” for grounding, bonding and interconnection of equipment to building and service grounds.

D. Permits and Fees:

1. Apply for, make payment, secure and obtain all necessary and required permits relative to work of this section.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. System design shall be by certified technician or registered Professional Engineer qualified in Lightning Protection System design.
2. Component sizing and selection for a complete system.
3. Design shall appear as a part of the building or structure, with conductors concealed within columns, walls and roof construction, where possible and practicable.
4. Select locations for equipment, which shall minimize need to disturb for future building maintenance and repair of roofing.

B. Performance Requirements: This is a performance specification. It is the full responsibility of the installer to ensure that the design and installation conforms to all applicable standards and Codes.

C. Structures less than 75 feet in height shall utilize Class 1 materials.
D. Provide UL Master Label system, as specified.

1.4 SUBMITTALS

A. General: Submit each item in this Section according to the conditions of the contract and Division 01 Specification Sections.

B. Submittals shall also comply with the submittal procedures and requirements of electrical Specification Sections.

A. Submittal Requirements of this section:

1. Roof plan showing system components.
2. Air terminals.
3. Roof, down, and counterpoise conductors.
4. Couplings, bonding plates and connectors.
5. Ground and bonding connections.
6. Adhesive and mechanical fasteners.
7. Roof penetrations and sealants.
8. Steel grounding connectors.
9. All other miscellaneous hardware.

B. Descriptive Data:

1. Manufacturer's specifications, data sheets.
2. Catalog cuts.
3. Dimensional drawings.
4. Installation Instructions.
5. Clearly indicate the exact size or rating proposed.
6. To verify specifications have been met/exceeded.
7. Indication of UL Listings.
8. Clearly indicate or state options, etc.:
    a. Manufacturer/catalogue number.
    b. Construction data, materials, as applicable.
    c. Label each conductor or cable type, and its proposed application or location.
    d. Identify each component with a cross reference to the drawings.
    e. Drawings and installation instructions.
    f. Details to demonstrate that the system has been coordinated and will function as one unit.

C. System Design Drawings:

1. Identify each component used in the system.
2. Indicate all building penetrations, and method proposed at each location.
3. Indicate attaching methods for all components.
4. Indicate proposed layout, including relationship to other parts of work.
5. Show proposed protection for all building accessories, roof top equipment, etc.
6. Drawings shall be stamped and signed by a licensed lightning protection

engineer.

D. Closeout Submittals: Submit in accordance with the General Conditions and Division 01requirements, Section “Common Work Results For Electrical”, and as follows:

1. Post installation ground resistance test results, per Section “Grounding & Bonding for Electrical Systems.”

1.5 ELECTRONIC AUTOCADD DOCUMENTS

A. Requests for electronic Autocadd documents will be accommodated to the contractors and installers upon receipt of Bowman’s Electronic Document Release Form. Refer to Section “Common Work Results for Electrical” for additional information.

1.6 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms “Listed and Labeled”: As defined in the National Electrical Code, Article 100 (NEC).
2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.
3. Where equipment consists of multiple components, the entire assembly or product shall be UL Listed and Labeled, or Labeled by a testing organization acceptable to the Authority Having Jurisdiction per the NEC.

B. Manufacturer’s Requirements:

1. Engaged in manufacturing of lightning protection systems and equipment at least 10 years.
2. Provide local maintenance and service with location less than 100 miles from project site.
3. Provide technical support to installer.
4. Maintain, within 50 miles from site, a maintenance and service organization complete with parts inventory and repair facility.
5. Materials shall be manufactured by an accredited member of the Lightning Protection Institute, in compliance with UL material Code 96.

C. Single-Source Responsibility:

1. The complete installation and performance of the installed system, including all accessories shall be the sole responsibility of the lightning protection system installer. It is the installer’s responsibility to ensure that all field installed accessories and loose components used in the system, meet these specifications, and perform up to the stated and tested standards.
2. Coordinate the components of the system and their arrangements electrically and mechanically.

D. Installer Qualifications:

1. Has installed a minimum of fifteen (15) lightning protection systems of similar size and conditions within the local area.
2. Has installed a minimum of five (5) UL Master Label systems, with successful UL

Listing upon completion.

3. Factory-authorized installer to perform work of this Section.
4. Provide references upon request:
   a. Names of six (6) similar projects in size and scope.
   b. Contact person and phone number for each project.

E. Installation Quality: In accordance with the following Codes and Standards.

1. NEC National Electrical Code
2. NETA National Electrical Testing Association
3. NFPA National Fire Protection Association
4. NLPI National Lightning Protection Institute
5. UL Underwriters Laboratories

F. Certification of all system components:

1. Catalogued by the system manufacturer.
2. UL Listing of each component individually.

1.7 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection:

1. Store all materials under cover, in trailers, buildings, etc.
2. Protect all materials from physical damage and exposure to weather, prior to installation.

1.8 PROJECT CONDITIONS

A. The lightning protection system and components shall be installed on the structure and all rooftop components, equipment and appurtenances. Refer to all other project specification sections and drawings for coordination with roof, structural and mechanical systems.

1.9 SEQUENCING

A. General Sequencing:

1. Coordinate lightning protection system installation with roof, steel, exterior and/or interior construction.
2. Coordinate lightning protection system installation with mechanical system components on roof, grade, etc. Do not install lightning protection components prior to completion of mechanical equipment requiring same.
3. Coordinate lightning protection system installation with solar system components on roof. Do not install lightning protection components prior to completion of rooftop PV system.
4. Provide for roof penetrations.
5. Provide for connections to steel, where applicable, prior to wall close-in or ceiling installations.
6. Provide for sub-grade roughins and stubouts.
7. Coordinate trenching and installation of sub-grade components to avoid damage. Do not install ground rods or counterpoise, prior to establishment of final grade elevations.

1.10 COORDINATION

A. Installer shall examine the structure and all items of construction affecting his work.

B. Coordinate installation with other trades, especially roofing and structural steel.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, provide a system by one of the following named manufacturers:

1. Erico-A/C, Inc.
2. Heary Brothers.
3. East Coast Lightning Equipment, Inc.
4. Harger Lightning and Grounding.
5. Dillon Lightning Protection Systems, Inc.

2.2 MATERIALS

A. System components shall be of copper or aluminum complying with the requirements of LPI, UL and NFPA for type and height of building.

2.3 CONDUCTORS

A. In compliance with NFPA 780, “Standard for the Installation of Lightning Protection Systems,” and UL 96, “Lightning Protection Components” as applicable for materials specified.

B. Main Aluminum Conductors:

1. Smooth weave construction.
2. Minimum 115 lbs/1000 LF.
3. Minimum #14 AWG individual conductor strands.
4. Minimum total area of conductivity: 115 kcmil.

C. Secondary Aluminum Conductors:

1. Smooth weave or solid construction.
2. Minimum #4 AWG conductor.
3. Minimum total area of conductivity: 41 kcmil.

D. Copper Counterpoise Conductor:

1. Concentric stranded construction.
2. Bare copper, soft temper per ASTM B8, “Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft."
3. Minimum #4/0 AWG.

2.4 AIR TERMINALS

A. Construction:

1. In compliance with NFPA 780, “Lightning Protection Code” and UL 96, “Lightning Protection Components.”
2. Minimum 18" in length.
3. Minimum 1/2" diameter.
4. Solid aluminum or nickel-plated copper, subject to installation requirements.
5. Threaded base.
6. Project a minimum of 10" above the protected object.
7. Supported by suitable, UL Listed braces with guides >50% the height of the terminal.

B. Safety tips for rods posing impalement risk.

1. Blunt safety tip to prevent injury to personnel.

C. Terminal Bases:

1. Cast bronze for copper air terminals.
2. Cast aluminum for aluminum air terminals.
3. Positive bolt tension cable clamping.
4. Suitable for bolted, adhesive, or nailed attachment to surfaces, as required.

2.5 GROUND RODS

A. As specified in Section “Grounding & Bonding For Electrical Systems.”

2.6 CONNECTORS

A. Construction:

1. In compliance with NFPA 780, “Lightning Protection Code” and UL 96, “Lightning Protection Components,” class as applicable.
2. Positive bolt tension cable clamping.
3. Dual CU/AL rated connectors where joining copper and aluminum conductors.
4. Cast bronze for copper air terminals.
5. Cast aluminum for aluminum air terminals.

2.7 MISCELLANEOUS COMPONENTS

A. Other components required for a complete lightning protection system such as bonding plates, terminal supports, clip, fasteners, etc. shall conform to NFPA 780, “Lightning Protection Code” and UL 96, “Lightning Protection Components” for applicable classes.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions: Examine the conditions under which the equipment shall be delivered, installed, and operated. Make all allowances required for installation and maintenance of the equipment, per Codes and manufacturer.

3.2 INSTALLATION

A. General Requirements:

1. Install all equipment, as indicated and per manufacturer's written instructions.
2. Do not install equipment where location impedes access to other equipment or creates unsafe conditions. Install in suitable, alternate location.
3. Coordinate the installation of the lightning protection system with the work of other trades and contractors prior to laying out system or beginning work.
4. Install per requirements of NFPA 780, "Lightning Protection Code" and UL 96A, "Installation Requirements for Lightning Protection Systems."

B. Air Terminals:

1. Rigidly connect to structure.
2. Make electrically continuous with roof conductors by means of pressure connectors or crimped joints.
3. At ends of structures, set <24" from end of ridge or edges and corners of roof.
4. Maximum spacing along ridges or roof edges of 20 feet.
5. Minimum height above protected objects: 10 inches.
6. Prevent overturning by means of tripod or braces.
7. Attach to mechanical equipment or other flat surfaces via adhesive, approved by terminal manufacturer for the intended application.
8. Provide terminals with safety tips in all locations on flat roofs, low parapets, and other locations where personnel may become injured due to falls onto the air terminal.

C. Roof Conductors:

1. Connect directly to roof or ridge at intervals not to exceed 36."
2. Avoid creation of U or V pockets on roof surfaces that can trap water or debris.
3. Prevent sharp bends or turns.
4. Minimum bend radius of 8 inches.
5. A minimum of two current paths shall be formed from every air terminal.
6. Provide a downward or horizontal course.
7. All connections shall be electrically continuous.
8. Follow contours of flat roofs, ridges, parapets & edges.
9. Concealed conductors shall be fastened as required to maintain position and hold permanently in place.

D. Down Conductors:

1. Interconnect secondary conductors with grounded parts within the building.
2. Electrically continuous from air terminals and roof conductors to ground rods and counterpoise.
3. Conceal down conductors within the building, as practicable. Protect in rigid non-metallic raceway (Sched 40 PVC) where passing through walls, floors, etc. Where conduit shall be exposed in plenum spaces, or where PVC is not permitted by Codes, install in EMT conduit.
4. Provide multiple ground paths between protection system and ground.
5. Minimum of two down conductors located as widely separated as possible, at diagonally opposite corners. Provide additional down conductors on larger buildings and structures.
6. All roof and down conductor connections and splices shall be compression type.

E. Bonding of Metal Bodies:

1. All metal bodies or objects permanently affixed to the structure and subject to direct lightning strike shall be provided with two current paths to the lightning protection system via full sized conductors.
2. Bond all grounded metal bodies within the protection zone(s) if within the calculated bonding distance.
3. Bond ungrounded metal bodies to the lightning protection system, as required by calculations and Codes.

F. Roof Penetrations:

1. Where the system requires penetration of the roof, make such penetration utilizing manufacturer's recommended products, approved by the roofing system installer.

G. Ground Conductor Connections:

1. Provide ground connection for each down conductor.
2. Protect ground connections from mechanical damage.
3. In making ground connections, utilize permanently moist areas as applicable.

H. Grounding Electrode System:

1. Provide a minimum of six (6) ground rods. Refer to site plan for approximate locations.
2. Ground rods shall be not less than 2, nor more than 10 feet from the foundation or structure.
3. Drive electrode into earth a minimum of 11 feet.
4. Install counterpoise around perimeter of the structure in a trench not less than 2 feet deep at a distance not less than 2 nor more than 10 feet from the structure.
5. Provide connections to counterpoise for each ground rod.
6. Bond all underground metal water pipes and other large metallic objects to the grounding counterpoise electrode system.
7. All underground connections between conductors, rods, etc. shall be exothermic weld type.
8. Interconnect lightning protection grounding electrode system to building electrical system ground.
9. Comply with NEC Article 250, "Grounding."

3.3 CONSTRUCTION

A. Corrosion Protection:

1. Avoid combination of materials, which form electrolytic couple of dissimilar metal.
2. Avoid connections in which corrosion is accelerated with moisture, unless moisture is permanently excluded from the union of such metals.
3. Use protective coatings where required.
4. Do not install copper components on aluminum roofing, flashing or near aluminum components where moisture can run off copper onto aluminum trim or surfaces.
5. Do not embed aluminum components in concrete or masonry.
6. Aluminum components shall not be in contact with soil.

B. Mechanical Protection:

1. Oversize conductors to compensate for physical hazard or protect with nonmagnetic molding or tubing.
2. Where metallic conduit is used, conductors shall be bonded to the conduit at upper and lower ends.

C. Steel Frame Buildings:

1. Steel framework shall be made electrically continuous by bolting, riveting or welding frame, or as specified in another section.
2. Connect air terminals to steel framework at the ridge. Short runs of conductors shall be used to join air terminals to the metal framework so as to maintain proper terminal placement.
3. Connections to steel shall be bolted or exothermic weld.
4. Column to ground rod/counterpoise connections shall be made at the bottom of steel columns. At least half of steel columns shall have ground connections, spaced equally around perimeter, including the four corners.
5. Metal doors, windows, gutters, etc. shall be bonded to the steel of the structure.

D. Building Grounding Electrode System Connections:

1. Provide direct connection from the Lightning Protection system to the building's main grounding bus bar.
2. Bonding to building grounding electrode system, including bonds to building steel, footing (UFER) ground, water service framework shall be made via common bonding to the main grounding bus bar.
3. Bonding to building electrical and ancillary systems, including telecommunications, CATV, etc. shall be made via common bonding to the main grounding bus bar.
4. LPS connections to main grounding bus bar shall be made via hydraulic crimped lugs, and bolted connection to bus bar.

3.4 REPAIR/RESTORATION

A. Restore all finishes, equipment, surfaces and/or grade to original condition, where affected by the work of this section.

3.5 FIELD QUALITY CONTROL

A. Installation shall meet all the requirements of UL Master Label for such systems.

B. Site Tests:

1. Schedule tests and provide notification at least one week in advance of any test commencement.
2. Post-Installation Testing: After completing system installation, perform the following preparations for tests:
   a. Make ground resistance tests for system, per Section "Grounding & Bonding For Electrical Systems."
   b. Inspect accessible components for cleanliness, mechanical, and electrical integrity, for presence of damage or deterioration. Correct all deficiencies are corrected.

c. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, where not available, those of UL Standards 486A, “Wire Connectors and Soldering Lugs for Use with Copper Conductors” and 486B, “Wire Connectors for Use with Aluminum Conductors.” Provide a written inspection checklist, which verifies all components have been inspected and are satisfactory.

C. System Certification:

1. The Installer and Owner shall complete the UL application for inspection.
2. The Owner’s representative shall witness and sign for the concealed grounding portion of the system, prior to covering with earth.
3. Installer shall complete all required UL forms indicating completion and authorizing a UL representative inspection.

D. UL Inspection:

1. Installer shall replace, repair or otherwise correct any deficiencies noted by the UL inspector.
2. Installer shall post the UL issued Certificate to the UL website,
3. Installer shall deliver a hard copy of the UL Certificate to the Owner.
4. System shall not be considered complete until final approval is received from UL as a Master Label system and UL issues the Certificate.

END OF SECTION

SECTION 26 50 00

LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Section Includes:

1. Lighting fixtures
2. LED Modules & Drivers
3. Photocells
4. Occupancy sensors
5. Digital Lighting Management System

B. Related Sections:

1. Section “Finishes” for coordination with mounting surfaces and materials.
2. Section “Common Work Results for Electrical” for labeling and other general requirements.
3. Section “Grounding & Bonding for Electrical Systems” for grounding and bonding requirements.
4. Section “Low Voltage Power Conductors and Cables” for 600V conductors.
5. Section “Raceways and Boxes for Electrical Systems” for conduit and raceway connections.
6. Section “Commissioning of Electrical Systems” for specific commissioning and functional performance testing requirements.

1.3 REFERENCES

A. ANSI

1. ANSI C78.377 Specifications for the Chromaticity of Solid State Lighting Products

1.4 SYSTEM DESCRIPTION

A. Performance Requirements: Performance of the lighting fixtures and controls is based on the specified and/or indicated products. It is the full responsibility of the installer to ensure that any differences in products do not deviate from the intended design or performance.

1.5 SUBMITTALS

A. Submittal Requirements of this section:

1. Individual lighting fixtures.
2. LED Modules/Drivers

3. Energy Star compliance for exit lights & selected fixtures
4. Occupancy sensors.
5. Digital lighting management system and components.
6. Lighting poles.
7. Certain fixtures have been selected based not only on performance, but on appearance, finish, shape, etc. Any substitutions shall be equal in performance and construction, as well as in appearance, as judged by the Owner or Architect. Where no equals are available, as determined by the Architect, submit the specified fixture.
8. Lighting control building layout
9. LEED Submittals: Comply with Section 018113
    a. SS Credit 6: Light Pollution Reduction
        1) For exterior luminaires, documentation indicating backlight, uplight, and glare ratings (BUG) rating.
    b. IN Credit 1: Reduced Mercury in Lamps
        1) Product data for all mercury-containing lamps, indicating mercury content and lamp life.

B. Descriptive Data:

1. Manufacturer's specifications, data sheets.
2. Catalog cuts.
3. Dimensional drawings.
4. Installation Instructions.
5. Wiring & connection diagrams.
6. Capacity ratings, performance curves.
7. Information required to indicate contract compliance.
8. Clearly indicate and/or mark options, etc.:
    a. Manufacturer/cat. number.
    b. Energy Star ratings.
    c. Design Light Consortium (DLC) compliance/listing.
    d. LED lamp input wattage, lumen output and color temperature (K).
    e. Coefficient of Utilization (C.U.) charts.
    f. Isofootcandle curves for exterior fixtures.
    g. Construction data, materials, lens type, reflector material, housing, as applicable.
    h. Warranty data.
    i. Color charts, where applicable.
    j. Fixture samples when requested.

C. Calculations:

1. Computer footcandle calculations, for any area when requested, and for the following areas:
    a. Parking Lots
    b. Corridors
    c. Offices
    d. Holding Cells
    e. Additional areas as requested
2. Interior Calculations, shall utilize the following parameters:
    a. 0.80 maintenance factor.
    b. 80/50/20 reflectances.
    c. Work plane – 30 inches AFF.
    d. Include racks or other solid obstacles, as shown.

3. Exterior Calculations, shall utilize the following parameters:
   a. 0.80 maintenance factor.
   b. Work plane – Finished grade.
4. Calculations, shall indicate the following information:
   a. Fc printout showing fc levels at 2 ft intervals, throughout illuminated areas (10 ft intervals for exterior calculations).
   b. Average, maximum and minimum fc levels.
   c. Ave/min and Ave/max ratios.
   d. Total quantity of fixtures.
   e. Total input watts for lighting system.

D. Wiring Diagrams:

1. Occupancy sensors and controls.
2. Digital lighting management systems.

E. Shop Drawings:

1. Digital lighting management systems.

F. Samples:

1. Provide fixture samples, when requested.
2. Sample shall be identical to the proposed fixture in color, lamp, physical size, etc.
3. Sample shall have a cord and plug, for connection to 120V, 20A wall receptacle.

G. Closeout Submittals: Submit in accordance with the General Conditions and Division 01 requirements, Section “Submittals”, and as follows:

1. Control system programming, setup and user controls.

1.6 ELECTRONIC AUTOCADD DOCUMENTS

A. Requests for electronic Autocadd documents will be accommodated to the contractors and installers upon receipt of Bowman’s Electronic Document Release Form. Refer to Section “Common Work Results for Electrical” for additional information.

1.7 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms “Listed and Labeled”: As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.
3. Where equipment consists of multiple components, the entire assembly or product shall be UL Listed and Labeled, or Labeled by a testing organization acceptable to the Authority Having Jurisdiction per the NEC.

B. Single-Source Responsibility

1. The complete performance of the assembled fixtures, mounts, poles, etc. including all accessories shall be the sole responsibility of the supplier. It is the

installer's responsibility to ensure that all factory and field installed accessories and loose components used in the system, meet these specifications, and perform up to the stated and tested standards.

2. Ensure that the complete fixture assembly complies with all individual component specifications, including LED's, drivers, etc.
3. Pole mounted fixtures: The manufacturer shall be responsible for the proper fit and performance of the fixture and pole, including attachment hardware, support arms, etc.

C. Manufacturer/Vendor Requirements:

1. Fixture manufacturer(s) shall have a minimum 15-year record of fixture manufacturing and in-service products of similar construction in the North American market.
2. All fixtures shall be domestically manufactured. Off-shore manufactured/assembled, imported fixtures are NOT permitted.
3. Ballast manufacturers shall have a minimum of 15 years of producing electronic ballasts for the North American market. Manufacturers shall be certified to ISO 9001 Quality System Standards.
4. Furnish lighting fixtures indicated, complete with LED's, drivers and mounting and/or suspension hardware.
5. Furnish interior lighting fixtures with proper trim kits, framing kits, supports, etc.
6. Furnish exterior fixtures mounted on the building with required back boxes to match mounting surfaces. Also include all pole mounted fixtures with pole standards.
7. Drawing fixture schedule generally indicates required features and/or performance. Manufacturers' catalog numbers are noted for reference and may not include all suffixes and prefixes of required features. Provide fixtures with all the features of the base catalog number provided and all additional options indicated.
8. Verify that proposed controls, dimming and other components which are to interface with the fixtures, drivers, etc. are fully compatible with the fixture, ballast or driver manufacturers' written instructions.
9. LED source manufacturers shall provide testing in accordance with LM-80. Along with a valid method of projecting LM-80 test results to L50 & L70 lumen maintenance values based on recommended operating conditions.
10. LED fixture manufacturers shall perform their own of junction temperature, drive current and other relevant factors and base the fixtures L50 & L70 values on LM-80 extrapolations provided by the LED source manufacturer.
11. LED fixture manufacturers shall base published photometric data on test results from an independent NI ST – traceable testing lab using photometry in accordance with LM-79.

D. Product Coordination Responsibility

1. The contractor and equipment vendor(s) shall insure that all proposed fixtures are fully compatible and matched with the proposed switches, lighting controls, dimmers and related lighting control components.

E. Installer Qualifications:

1. Experienced in the installation and connection of all proposed fixture types, control components, and all other specified equipment.

F. Installation Quality: In accordance with recognized trade organizations and standards.

1.	ANSI	American National Standards Institute
2.	ASME	American Society of Mechanical Engineers
3.	ASTM	American Society for Testing and Materials
4.	IEEE	Institute of Electrical and Electronics Engineers
5.	NEC	National Electrical Code
6.	NECA	National Electrical Contractors' Association "Standards of Installation."
7.	NEMA	National Equipment Manufacturers Association
8.	NETA	National Electrical Testing Association
9.	NFPA	National Fire Protection Association
10.	UL	Underwriter's Laboratories

1.8 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Provide all transportation of unit(s) to site.
2. Provide for rigging needed for unloading poles/crossarm assemblies, and other large equipment, and setting into final position.

B. Storage and Protection:

1. Store all fixtures in original packaging, as recommended by manufacturer.
2. Store all fixtures in covered storage or building, out of the weather, until installation.
3. Protect from physical damage and deterioration from heat, moisture, etc.
4. Do not store electronic or sensitive components (i.e. occupancy sensors, control systems, etc.) in areas of high heat or humidity, which might create corrosion or other deterioration.
5. Store poles in horizontal position, on-grade with proper supports to prevent sagging and scratches.

1.9 PROJECT CONDITIONS

A. Inmate/Prisoner Detention Areas: Project includes work and equipment to be installed in detention environments. All materials and methods shall be suitable for such "Maximum Security" environment. This includes requirements for heavy duty equipment construction, tamperproof equipment and hardware and special construction tolerances/workmanship, as specified herein.

1. Detention facilities shall have "maximum security" correctional grade fixtures, unless indicated otherwise.

1.10 SEQUENCING

A. General Sequencing:

1. Coordinate layout and installation of fixtures with other installations.
2. Provide input to coordinated construction layout drawings to ensure fixtures are installed as designed. Revisions to locations and elevations from those indicated shall be made only after consulting the Engineer/Architect, as required to suit field conditions and as approved by the Owner.

3. Coordinate actual fixture depths and locations with piping, ductwork, cable trays, bulkheads, and other ceiling mounted equipment, etc. prior to rough-in.

1.11 WARRANTY

A. Special Warranty: Extended product warranty over and above that required by the Contract and General Conditions of this contract.

1. LED fixtures (complete assembly): 5 years
2. Vandal-resistant fixture housing/lenses: Lifetime
3. Exterior pole finishes: 5 years
4. Occupancy sensors & switches: 5 years
5. Digital and low voltage switches: 5 years
6. Digital lighting management system: 5 years

1.12 SYSTEM STARTUP

A. Manufacturer's Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of the following system, associated components and accessories, and the pretesting, programming and/or adjustment of all settings, components and accessories.

1. Digital lighting management systems.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, provide the named “Basis of Design” manufacturer and model (“Basis of Design” fixtures are indicated on the drawing fixture schedule), or a comparable product of one of the other following named manufacturers:

1. Interior Lighting Fixtures:
   a. H.E. Williams
   b. Lithonia Lighting
   c. Pinnacle Lighting
   d. Spectrum Lighting
   e. Elite Lighting
   f. Visa Lighting
   g. Alphabet Lighting
   h. Emergilite
   i. Columbia Lighting
   j. Cooper Lighting
   k. Kenall Lighting
   l. Daybrite Lighting
   m. Finelite, Inc
   n. Ledalite
   o. Focal Point Lighting
   p. New Star
   q. Hubbell Lighting
2. Exterior Lighting Fixtures:
   a. U.S. Architectural Lighting
   b. Lithonia Lighting

c. Cooper Industries - Crouse Hinds Lighting
d. General Electric Co.
e. Kenall Lighting
f. New Star
g. Spaulding
h. Gardco
i. FC Lighting
j. LSI Industries
k. Cree Lighting
l. Cole Lighting

3. Vandal Resistant Lighting Fixtures:
   a. New Star
   b. Lithonia Lighting
   c. Columbia Lighting
   d. Cooper Industries
   e. Kenall Lighting
   f. Luminaire Lighting
4. LED Modules & Drivers:
   a. Philips Advance
   b. CREE
   c. Samsung
5. Occupancy Sensors & Switches:
   a. Leviton
   b. LeGrand - Watt Stopper
   c. Sensor Switch
   d. Hubbell
6. Digital Lighting Management Systems & Sensors:
   a. Leviton
   b. Legrand - Watt Stopper
   c. Sensor Switch
   d. Hubbell

2.2 GENERAL REQUIREMENTS

A. Listing/Labeling:

1. UL listed and labeled fixtures and wiring.
2. UL Damp or Wet location listed, as indicated or required.
3. UL hazardous area listed for Class, Division, and Group.

B. Mounting Accessories:

1. Fixture schedule generally indicates catalog number for lay-in tile ceilings.
2. Refer to Architectural drawings for ceiling types.
3. Provide fixture surface mounting kits, recessed framing kits, hardware, supports, hangers, etc., as required.

2.3 CONSTRUCTION FEATURES

A. LED Fixtures:

1. LED light source shall be shielded from direct view (interior fixtures).
2. One piece die-cast housing designed specifically for LED lamps/drivers.
3. Thermal control to ensure cool running LED’s.

4. All LED fixtures shall have a similar color temperature (degree K) rating to prevent visible lamp color differences.
5. Replaceable LED module and driver.
6. All LED fixtures, modules and drivers shall be RoHS compliant.

B. LED Exit Light Fixtures:

1. Backlit LED lamp source through stencil face(s) with translucent diffuser panel(s).
2. Listed as a qualifying NEMA Premium Exit Sign Program fixture.
3. Compliant with NEMA's "*EM-1 Standard for Premium Exit Signs*".
4. Tested in accordance with applicable UL and CSA Standards.
5. Products shall bear a special mark to indicate NEMA compliance.
6. Thermal control to ensure cool running LED's.
7. GREEN LED's and/or panels for Baltimore County projects.

C. Exterior Fixtures:

1. Cast aluminum housing, unless noted.
2. Dark bronze finish, or as selected by Architect.
3. UL Listed for Damp or Wet Location, as required.
4. Weatherproof gasketing.
5. Corrosion resistant hardware and materials.
6. Photocell, as indicated.

D. Tamper Proof Hardware

1. Provide tamper proof hardware for all fixtures, housings, fixture guards, etc. installed under this Division where such equipment is accessible to prisoners at any time. Such locations are indicated on the contract drawings.

2.4 LED MODULES & DRIVERS

A. Minimum Requirements:

1. U.L. Listed.
2. High Efficiency, solid state driver.
3. Minimum rated life of 50,000 hours at 70%.
4. 3500K color temperature, unless otherwise noted or specified.
5. CRI of 80 (minimum).
6. RoHS compliant.
7. Dimmable and compatible with all 0-10V dimming switches.
8. Philips Xitanium drivers, or approved equal.
9. All LED fixtures shall be supplied with integral or external/remote drivers. Where LED fixtures do not have integral driver(s), provide required LED driver(s) as recommended by the LED manufacturer, matching all operational requirements of the LED lamps, modules, etc.

B. Construction Features:

1. Driver shall include all metal-can construction for optimal thermal performance.
2. Driver shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage) with no damage to the Driver.
3. Output shall be regulated to +/- 5% across published load range.
4. Minimum input Power Factor > 0.90 for for 50-100% of full load.

5. Input current Total Harmonic Distortion (THD) < 20%.
6. Class A sound rating.
7. Minimum operating temperature of -4°F.
8. Driver shall tolerate sustained open circuit and short circuit output conditions without fail and auto-resetting without need for external fuses or trip devices.
9. UL Listed for Damp and Dry locations.
10. Integral common mode and differential mode surge protection of 2.5kV(100kHz 30ohm ring wave).
11. Integral thermal fold-back to reduce driver power above rated case temperature to protect the driver if temperatures reach unacceptable levels.
12. Meets NEMA 410 for in-rush current limits.
13. Integral means of limiting surges to the LEDs.
14. Underwriters Laboratories (UL) recognized Class 2 per UL1310.
15. 5-year limited warranty from date of manufacture against defects in material or workmanship, including replacement.
16. Dimmable drivers shall be controlled by a Class 2 low voltage 0-10VDC controller with dimming range controlled between 1 and 8VDC with source current 150µA.

C. Outdoor LED Driver Construction Features:

1. Integral common mode and differential mode surge protection of 3kV (1.2/50µs, 2ohm combination wave).
2. Minimum operating temperature of -40°F.
3. Backlight Ratings.
4. Luminaire up light rating.
5. Glare Rating.
6. LED Fixtures.

2.5 PHOTOCELLS

A. For single fixture control:

1. Integral with fixture where applicable.
2. Control only fixture where mounted.
3. Separately mounted photocells, not acceptable, unless otherwise indicated.

B. For multiple fixture/contactor control:

1. Permanently wired & mounted in weatherproof box.
2. 1/2" threaded fitting for knockout or threaded hub.
3. Omni-directional via threaded fitting.
4. UV treated translucent dome.
5. Adjustable photocell shield.
6. 2000W tungsten, 1800 VA ballast load.
7. 120, 208 or 277 V, as required.
8. Tork Model 2000, or equal.

C. All Photocells:

1. Delayed action on and off to prevent false switching.
2. Positive, snap action switching to prevent on-off cycling at dawn and dusk.
3. Integral photocells by the fixture manufacturer, installed at the factory. Integral twist-lock type photocells are acceptable if installed as a permanent part of the fixture.

2.6 LINE VOLTAGE OCCUPANCY SENSORS

A. Device Color: WHITE except as otherwise indicated.

B. Sensor requirements:

1. 120V or 277V operation, as applicable.
2. Sensitivity adjustment with LED for calibration.
3. Manual-On control of load(s) per latest IECC requirements.
4. 5 year warranty from manufacturer.
5. Adjustable sensitivity and time delay settings.

C. Wall Switch PIR Sensor:

1. Passive infrared.
2. 180° coverage.
3. Coverage: 900 sq. ft. maximum, 300 sq. ft. for desktop activity.
4. Maximum load; 800W @ 120V, 1200W @ 277V.
5. 2 level, 36 segment fresnel lens.
6. Button(s) for Manual-On of load(s) in compliance with IECC.
7. 2-Relay switches with two individual manual buttons for dual-circuit lighting, bi-level lighting, or lighting & plug-load controls, where indicated.
8. Leviton, or approved equal.

D. Wall Switch Dual Technology Sensor:

1. Combination Passive Infrared and Ultrasonic sensing.
2. 180° coverage.
3. Coverage: 900 sq. ft. maximum, 300 sq. ft. for desktop activity.
4. Maximum load 800W @ 120V, 1200W @ 277V.
5. 2 level, 36 segment fresnel lens.
6. 40kHz ultrasonic detection.
7. Button(s) for Manual-On of load(s) in compliance with IECC.
8. 2-Relay switches with two individual manual buttons for dual-circuit lighting, bi-level lighting, or lighting & plug-load controls, where indicated.
9. Leviton, or approved equal.

E. Wall 0-10V Dimmer Switch PIR Sensor:

1. Passive infrared.
2. 180° coverage.
3. Coverage: 1000 sq. ft. maximum.
4. Maximum load (fluor); 1000W.
5. 2 level, 36 segment fresnel lens.
6. 0-10VDC dimming control.
7. Button(s) for Manual-On of load(s) in compliance with IECC.
8. Individual buttons for ON/OFF and UP/DOWN dimming control.
9. Leviton, or approved equal.

F. Wall 0-10V Dimmer Switch Dual Technology Sensor:

1. Combination Passive Infrared and Ultrasonic sensing.
2. 180° coverage.

3. Coverage: 900 sq. ft. maximum, 300 sq. ft. for desktop activity.
4. Maximum load 800W @ 120V, 1200W @ 277V.
5. 2 level, 36 segment fresnel lens.
6. 40kHz ultrasonic detection.
7. 0-10VDC dimming control.
8. Button(s) for Manual-On of load(s) in compliance with IECC.
9. Individual buttons for ON/OFF and UP/DOWN dimming control.
10. Leviton, or approved equal.

2.7 DIGITAL LIGHTING MANAGEMENT SYSTEM

A. Sensor requirements:

1. Suitable for use on 120V or 277V lighting systems, as applicable.
2. 24VDC operation.
3. Sensitivity adjustment with LED for calibration.
4. Uses Cat 5e cable for interconnection of components.
5. 5 year warranty from manufacturer.
6. Adjustable sensitivity and time delay settings.
7. Manual-On control of load(s) per IECC requirements.

B. Ceiling Mount Digital Dual Technology Sensor

1. Input voltage: 24VDC from DLM network.
2. DML local network connection: 2-RJ45 ports.
3. Infrared (IR) transceiver.
4. Ultrasonic frequency.
5. Plug n’ Go automatic configuration.
6. Leviton GreenMAX DRC Wired Series.

C. Ceiling Mount Digital Ultrasonic Sensor

1. Input voltage: 24VDC from DLM network.
2. DML local network connection: 2-RJ45 ports.
3. Infrared (IR) transceiver.
4. Ultrasonic frequency.
5. Plug n’ Go automatic configuration.
6. Leviton GreenMAX DRC Wired Series.

D. Ceiling Mount Digital PIR Sensor

1. Input voltage: 24VDC from DLM network.
2. DML local network connection: 2-RJ45 ports.
3. Infrared (IR) transceiver.
4. Ultrasonic frequency.
5. Plug n’ Go automatic configuration.
6. Leviton GreenMAX DRC Wired Series.

E. Dimming and On/Off Photosensor

1. Single zone or multiple zone
2. Ceiling mounted
3. Infrared transceiver
4. 100 º spatial response
5. DLM local network connection: 1-RJ45 port via RJ45 plug and coupler (included)
6. Setpoints from 1-1553 footcandles
7. Leviton GreenMAX DRC Wired Series.

F. Dimming Room Controller (for dimming control of 0-10V dimmable fixtures)

1. Maximum 20A combined load per Room Controller; each output rated for 20A
2. Operates on 120/277 VAC 50/60Hz
3. Class 2 dimming control signal : 0-10VDC, sinking or sourcing (automatic adjustment based on load)
4. Class 2 outputs to DLM local network: 24VDC, 250mA across 4-RJ45 ports
5. Plug n' Go automatic configuration.
6. On/Off/Dim button for each load.
7. Leviton GreenMAX DRC Wired Series.

G. Universal Dimming Room Controller (for fixtures to be dimmed that do not have 0-10v dimming capability)

1. Maximum 20A combined load per Room Controller; each output rated for 20A: tungsten, MLV, ELV or LED (forward phase compatible transformers or drivers)
2. Operates on 120/277 VAC 50/60Hz
3. Class 2 outputs to DLM local network: 24VDC, 150mA across 4-RJ45 ports
4. Plug n' Go automatic configuration.
5. On/Off/Dim button for each load.
6. Leviton GreenMAX DRC Wired Series.

H. 0-10V to Phase Adaptive Converter (for dimming non 0-10v fixtures)

1. Voltage: 120–277VAC; 60Hz
2. Power: 750W at 120VAC, 1300W at 277VAC
3. Control: 0-10V Input
4. 24W minimum load
5. Standby Power:
   – 0.75W@120V
   – 1.87W@277V
6. Housing: Aluminum
7. Operating Temperature: -40°F to 140°F (-40°C to 60°C)
8. Mounting: Screws or through-hole hardware via built-in bracket
9. Plenum rated
10. 5 year warranty
11. Leviton GreenMAX DRC Wired Series.

I. Room Controller (for ON-OFF switching control of fixtures)

1. 1 relay or 2 relay.
2. Operates on 120/230/277 VAC 50/60Hz 20 amp feed.

3. Class 2 outputs to DLM local network: 24VDC, 250mA across 3-RJ45 ports
4. Plug n' Go automatic configuration.
5. On/Off button for each load.
6. Leviton GreenMAX DRC Wired Series.

J. Emergency Lighting Control Unit

1. Provides interface between normal lighting room controller and emergency fixtures to be similarly controlled.
2. Wired as shunt (bypass) device to allow emergency circuit fixtures to be switched/dimmed with regular room fixtures.
3. UL924 Listed device.
4. Leviton GreenMAX DRC Wired Series.

K. Digital Wireless Configuration Tool(for digital occupancy sensor configuration)

1. Easy to read LED screen
2. Adjustable occupancy sensor parameters include sensitivity, time delay, trigger and re-trigger modes.
3. Remotely reconfigures DLM daylighting controller settings (day and night set point, raise and lower levels)
4. Leviton GreenMAX DRC Wired Series.

2.8 DIGITAL SWITCHES

A. Device Color: WHITE except as otherwise indicated.

B. Digital On/Off Wall Switches

1. 24VDC from DLM local network
2. DLM local network connection: (2) RJ45 ports
3. Buttons can be programmed for on-off or dimming up-down controls.
4. Infrared transceiver
5. Hidden configuration button to access "Push 'n' Learn" feature.
6. 1, 2, 3, 4 or 8 control button(s) each with LED status indicator button.
7. Mounts in decora style wall plate.
8. Leviton GreenMAX DRC Wired Series.

C. Digital Dimmer Wall Switches (for single zone location)

1. 24VDC from DLM local network
2. DLM local network connection: (2) RJ45 ports
3. Single button for ON/raise, or lower/OFF controls.
4. Infrared transceiver.
5. Hidden configuration button to access "Push 'n' Learn".
6. Blue ON LED indicator.
7. 7 LED dimming level indicator.
8. Single Control Button with LED level indicator.
9. Mounts in decora style wall plate.
10. Leviton GreenMAX DRC Wired Series.

D. Digital 5-Button Scene-Control Dimmer Switch (for multi-zone(scene) controls)

1. 24VDC from DLM local network
2. DLM local network connection: (2) RJ45 ports
3. Infrared transceiver
4. Hidden configuration button to access “Push ‘n’ Learn”
5. Control button with 4 scene/zone buttons
6. ON/Off-Raise/Lower Master Paddle
7. Control Button with LED indicator.
8. Custom engraving to identify each scene/zone button.
9. Mounts in decora style wall plate.
10. Leviton GreenMAX DRC Wired Series.

2.9 LOW VOLTAGE CONTROL CABLING

A. Cables for low voltage dimming or control systems shall be as recommended by the control system manufacturer.

B. All low voltage cabling installed on this project shall be UL Listed, plenum rated cable.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions: Examine the conditions under which the equipment shall be delivered, installed, and operated. Make all allowances required for operation, access and maintenance of the equipment, per Codes and manufacturers.

3.2 INSTALLATION

A. Fixture Installation - General:

1. Provide even, symmetrical spacing of fixtures.
2. Coordinate with diffusers, grilles and access panels in ceilings to establish a symmetrical pattern.
3. Support all fixtures independent of ceiling systems, ducts and piping.
4. Provide hangers from purlins, joists, beams, etc., for support of all boxes and fixtures.
5. Provide trapeze hanger supports for fixtures under ducts, large pipes, etc.
6. Galvanized steel for all hangers, channels, bolts, etc.
7. No fixtures shall be supported solely by grid or gypsum board ceilings.
8. Maintain required clearances around fixtures according to manufacturer’s written instructions.
9. Drawings are general in nature and show approximate mounting locations of fixtures. Follow spacing dimensions, where indicated on architectural or reflected ceiling plans.
10. Coordinate exact roughins during construction to center and align fixtures, as applicable.
11. Coordinate wall mounted fixtures with other wall materials and items (TV/monitors, fire alarm devices, downspouts, etc.).

B. Recessed Fixtures:

1. Support recessed fixtures with galvanized tie wires, at two opposite corners of

fixture.
2. Provide framing for all recessed fixtures.
3. Plaster frames for plaster or GWB ceilings.
4. Provide sloped ceiling adapters, where applicable.
5. Make electrical connections using flexible conduit, concealed above finished ceilings.

C. Surface Mounted Fixtures:

1. Install fixtures tight to ceiling or wall surface with no visible gaps.
2. Support fixture using rigid rods, channels, etc. Do not support from ceiling grid system or with wires.
3. Tighten attaching hardware evenly and per manufacturer's instructions to prevent warping or distortion of fixtures.
4. Provide recessed backbox to allow fixture mounting tight to surface.
5. Make electrical connections through rear of fixture, concealed as practicable.

D. Suspended Fixtures:

1. Provide hangers, rods, suspension cables, etc. for suspended fixtures, per drawings.
2. Install fixtures level and will all support rods or cables plumb.
3. Securely attach fixture to rigid supports, where applicable, to prevent wobble.
4. For continuous row fixtures, install rows straight and level. Provide supports at intervals, per manufacturer.
5. Make electrical connections from above, through top of fixture(s). Minimize visible cable or hollow rod wiring drops by using through-wiring of continuous row fixtures, as permitted by manufacturer.

E. LED Tape Light Mounting in Ceiling Light Coves:

1. Install LED tape light using 45-degree mounting channels, allowing for LED aiming up and out of cover.
2. Insure LED's are not visible to room occupants.
3. Install associated drivers in lighting cove, if concealment from view is possible. Where cove dimensions, etc. do not permit concealed mounting, install drivers above accessible tile ceiling or in GWB ceiling with access panel.
4. Provide multiple drivers where LED tape light length exceeds the output rating of a single driver.

F. Remote LED Drivers:

1. Where LED fixtures have external or remote LED drivers, provide complete installation of fixtures, drivers, and all interconnecting wiring.
2. Mount drivers where accessible for maintenance or replacement.
3. Drivers shall mount in UL listed metal enclosures, suitable for the indoor or outdoor location where installed, following instructions of the driver manufacturer.
4. Provide flexible metal conduit for enclosing low voltage LED driver wiring to the fixture, as required for protecting the wiring from damage.

G. Electrical, Mechanical and Utility Room Fixture Installation:

1. Drawings provide the general layout of fixtures, quantities, circuiting, etc.
2. Provide adjustments to fixture locations, elevations and supports, as required to

coordinate fixtures with installed mechanical and electrical system equipment and maintain an even lighting distribution.

3. Do not install fixtures fully or partially above pipes, conduits, flues, hangers, or other equipment.
4. Install fixtures over walkways and where light will illuminate equipment fronts, controls, etc. Do not locate directly above boilers, chillers, switchboards, etc.
5. Fixtures shall be installed where accessible for future lamp and ballast maintenance, without need for special scaffolding, other than step ladders.

H. Security, Detention and Inmate Area Fixture Installation:

1. Fixtures shall be installed per manufacturer's instructions to prevent any and all movement of fixture.
2. Fixtures shall be substantially supported and attached to the building structure or secure ceiling structure.
3. All fixtures shall have tamperproof hardware (torx center pin).
4. Recessed fixtures shall not permit upward movement such that contraband or items can be inserted between fixture and surrounding ceiling or trim.
5. Surface fixtures shall be installed to prevent any gaps between fixture and mounting surface. Fixture shall be sealed to permanent surfaces (drywall, security ceiling or concrete) with permanent sealant/adhesive to prevent insertion of paper or other objects between fixture housing and mounting surface.

I. Pole Mounted Fixtures:

1. Coordinate pole lights and foundations, anchor bolts and fixture orientations.
2. Properly aim all fixtures per the specified distribution patterns.
3. Provide driven rod at each foundation for grounding each lighting pole.
4. Determine exact pole base location prior to excavation or drilling.
5. Mark all pole locations and verify coordinate with all other trades prior to installation.
6. Repair damage to new or existing utilities, caused during installation, shall at no cost to Owner.
7. Provide foundations for all light poles.
8. Poured in place concrete with reinforcing steel and PVC conduit wiring sleeves.
9. Foundation reinforcing shall be per drawings, or as follows, if not indicated:

	Footings		Rebar Size	
Pole Hgt (H)	Depth	Diam	Vert	Ties
H<15'	48"	18"	#5	#3
15'≤H<20'	48"	24"	#6	#3
20'≤H<25'	60"	24"	#8	#4
25'≤H<30'	72"	24"	#8	#4

10. Bases shall extend a minimum of 4" above finished grade (exposed), or as indicated on drawings.
11. Sonotube bases shall be bagged and rubbed.
12. Grout all spaces between top of foundation and bottom of pole base with non-shrink grout. Taper grout for water runoff.

J. Occupancy/Vacancy Sensor Installation:

1. Install in ceiling or wall, per actual manufacturer's instructions. Drawings are not to be used for exact placement.

2. Infrared sensors:
   a. Position sensor for optimal coverage and sensing within the control zone, per manufacturer's instructions.
   b. Locate so that sensors are not aimed directly through normally open doorways, cased openings, etc.
   c. Do not aim sensing elements at open doors or windows.
   d. Provide masking of IR coverage pattern to avoid detection outside the control zone.
   e. Maintain maximum distance from heating registers, convectors, unit heaters, and other moving hot air sources.
3. Ultrasonic sensors:
   a. Position sensor for optimal coverage and sensing within the control zone, per manufacturer's instructions.
   b. Locate so that sensors are not aimed directly through normally open doorways, cased openings, etc.
   c. Maintain maximum distance from air devices, and other sources of moving air.
   d. Do not aim sensing elements at open doors or windows.
4. Wall PIR Sensor Switch:
   a. Position sensor on wall for optimal coverage of the room control zone, per manufacturer's instructions.
   b. Locate so that sensors are not aimed directly through normally open doorways, cased openings, etc.
   c. Do not place sensors on walls perpendicular and distant from the main room activity (ie an office desk area).
   d. Provide masking of IR coverage pattern to avoid detection outside the control zone.

K. Control Switches, Devices and Occupancy Sensor Switch Installation:

1. Install all equipment plumb and level.
2. Install devices tight to boxes, etc. such that no movement occurs during normal operation.
3. Install cover plates tight to surrounding surface. Cover plate shall not provide the only means of support for wiring devices.
4. Where multiple devices are installed at the same location and elevation, use a single, multi-gang box and single cover plate, as applicable.
5. Where wiring devices, such as occupancy, dimmer, timer or other control switches, require a grounded conductor (neutral) connection for operation, install neutral conductor to the mounting box. Do not connect device neutral to equipment ground wire.
6. Where standard toggle switches are installed serving lighting loads in areas described in NEC 404.2(C), provide a grounded conductor (neutral) to the switch device box location as specified. Do not connect device neutral to equipment ground wire.
7. Match the rough-in heights of similar wiring devices in the project. Unless noted otherwise, the following mounting heights shall be used:
   a. Line and Low Voltage wall switches: 48" AFF to center.
   b. Occupancy sensor switches: 48" AFF to center

3.3 CONSTRUCTION

A. Grounding: Ground fixtures, housings, poles, and supporting equipment frames and enclosures per NEC and as specified in Section "Grounding & Bonding For Electrical

Systems."

B. Connections: Tighten joints, connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torque requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors".

3.4 REPAIR/RESTORATION

A. Restore all finishes, equipment and surfaces to original condition, where affected by the work of this section.

3.5 ADJUSTING

A. General:

1. Adjust aiming of all fixtures with adjustable optics or housings.
2. Rotate downlight trims for proper orientation of louver blades or wall wash reflectors.

B. Occupancy Sensor Adjustments:

1. Provide masking or blocking of PIR sensors and wall switches, as required to limit sensitivity to within the intended room/area only.
2. Provide field adjustments to sensitivity and range, appropriate to the activity planned in the area, coverage area, etc.
3. Provide shielding to limit sensitivity to nearby illumination sources, as required.
4. Re-adjust any sensors for improved operation per Owner direction.
5. Adjust footcandle level settings for sensors with daylight sensing.
6. Set "Time Delay Off" adjustments, as follows:
   a. Toilet Rooms: 15 minutes
   b. Classrooms: 15 minutes
   c. Individual Offices: 15 minutes
   d. Conference Rooms: 15 minutes
   e. Copy Rooms: 15 minutes
   f. Break/Lunch Rooms: 15 minutes
   g. Storage Rooms: 15 minutes
   h. Public Corridors: 20 minutes
   i. Other areas not listed: 20 minutes

C. Interior Photo-Sensor Adjustments (For Daylighting/Dimming Applications):

1. Provide field setup and adjustments for all individual spaces with daylight harvesting and automatic fixture on-off or dimming controls.
2. Adjust initial photo-sensor for desired interior footcandle levels with no daylight contributions (to be accomplished at night).
3. Adjust photosensor and control system to maintain fc levels by gradually dimming the fixtures in the daylighting zone, while maintaining the target fc levels in the space.
4. Re-adjust any sensors and dimming processes for improved operation per Owner direction.

D. Exterior Photocell Sensor Adjustments:

1. Where possible, set photocell aiming toward North sky.
2. Provide field adjustments to lighting sensitivity, appropriate to the activity planned in the area.
3. Provide shielding to limit sensitivity to any nearby illumination sources, as required.
4. Re-adjust any sensors for improved operation per Owner direction.

3.6 CLEANING

A. General: Clean all fixtures after work of all trades is complete, and prior to turnover to Owner.

1. Remove paint splatters and other spots, dirt, and debris.
2. Touch up scratches and mars of finish to match original finish.
3. Remove protective films, etc. from all devices, controls, etc.
4. Remove all wire clippings, etc. from interior of fixtures.
5. Adjust louvers, shielding, etc. for proper and consistent orientation.
6. Thoroughly wipe clean all surfaces with degreaser/cleaner, suitable for material.
7. Leave no visible dirt or fingerprints on lenses, louvers, housings, reflectors, lamps, etc.

3.7 DEMONSTRATION

A. Owner Demonstrations: Provide a factory trained representative for each system and type of equipment, for the purpose of training owner's personnel:

1. Discuss proper operation, maintenance, and use of all equipment.
2. Demonstrate periodic Owner testing and/or inspection of equipment.
3. Demonstrate adjustment to Owner-accessible equipment and systems.
4. Instructors shall be fully knowledgeable of the installed equipment and all components.
5. Training shall be completed at the project site following Owner occupancy, at Owner’s discretion.
6. Schedule after all final tests, adjustments and Owner's acceptance.
7. Training shall include use of delivered O&M manuals for each system or equipment.

B. Occupancy Sensor Demonstration:

1. Provide working demonstration for each type of sensor installed.
2. Explain function, delay settings, adjustments, etc.

3.8 COMMISSIONING

A. This project includes Commissioning of selected systems and components. Provide for commissioning of the Lighting and control systems, as required per Section “Commissioning of Electrical Systems”, and the Commissioning Plan.

END OF SECTION

SECTION 27 05 26 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

1.1 GENERAL

1.2 SUMMARY

A. Section Includes:

1. Grounding/Earthing and bonding for Low Voltage systems such as telecommunications and audiovisual systems.

2. Primary Bonding Busbar (PBB)

3. Secondary Bonding Busbar (SBB)

4. Telecommunications Bonding Backbone (TBB)

5. Backbone Bonding Conductor (BBC)

6. Rack Bonding Busbar (RBB)

7. Telecommunications Equipment Bonding Conductor (TEBC)

8. Telecommunications bonding conductor (TBC)

9. Pathways.

B. Related Sections:

1. Division 26 Section *Grounding and Bonding* for building systems with which to interface with Work of this Section.

1.3 DEFINITIONS

A. AFC: Above Finished Ceiling

B. BICSI: Building Industry Consulting Service International.

C. Bonding: Permanent joining of metallic parts to form an electrically conductive path to ensure electrical continuity and capacity to safely conduct current.

D. Common Bonding Network (CBN) – The principal means for affecting bonding and earthing inside a building.

E. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

F. EMI: Electromagnetic interference.

G. Ground/Earth – A conducting connection, whether intentional or incidental, by which an electric circuit or equipment is connected to ground, or to some conducting body of relatively large extent that serves in place of the ground.

H. HC: Horizontal Cross Connect

I. IDC: Insulation displacement connector.

J. LAN: Local Area Network.

K. MC: Main Cross-connect

L. NEBS: Network Equipment Building System.

1. NEBS Level 3: Equipment complies with strict specifications for fire suppression, thermal margin testing, vibration resistance including seismic, airflow patterns, acoustic limits, failover and partial operational requirements such as chassis fan failures, failure severity levels, RF emissions and tolerances, and testing/certification requirements.

M. NEC: National Electric Code

N. RCDD: Registered Communications Distribution Designer.

O. TR: Telecommunications Room

P. UTP: Unshielded twisted pair.

1.4 SYSTEM DESCRIPTION

A. Provide a complete and functioning Telecommunications grounding/earthing system inclusive of all hardware, software and training to meet or exceed the performance features outlined in this document.

B. Purpose: Telecommunications grounding/earthing system creates a low impedance path to earth ground to prevent damage to equipment and disruption in service due to electrical surges and transient voltages.

C. Grounding/earthing system comply with following:

1. NEC and local electrical codes

2. ANSI/TIA-607-D or latest version.

3. ISO/IEC 30129

4. IEEE 1100

D. Secondary Bonding Busbar (SBB): Ground/earth each telecommunications space to the Primary Bonding Busbar (PBB) located at the telecommunications entrance room.

1.5 SUBMITTALS

A. Comply with Division 01330 Section *Submittal Procedures*.

B. Submittal data is to be submitted electronically. Each submittal shall contain the below in the following order:

1. Cover Sheet.

    a. Include name of supplying contractor and project name.

2. Detailed Bill of Materials.

    a. Include a listing of: component quantities, equipment manufacturer, model number, and description of each component being supplied, and the specification paragraph or drawing sheet that corresponds to the product. Failure to provide this information will result in the rejection of submittals.

3. Product Data.

    a. Include a catalog sheet per product of equipment listed in the Detailed Bill of Materials, in the exact order as the Detailed Bill of Materials. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include an image of the product. Photocopy duplications of the manufacturer's original equipment catalog sheets will be allowed as long as they provide adequate clarity of both the printed word and graphics/pictures. If more than one product is shown on the catalog sheet the intended product must be denoted by either an arrow or highlight.

C. Shop Drawings

1. Wiring diagram to show grounding schematics, including the following: Busbars and bonding backbone. Detail mounting assemblies and show elevations and physical relationship between the installed components.

2. Show the relationship of TR's, the pathway between them, and cable connectivity to be installed.

3. Drawings should be at project standard scale clearly legible.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements, grounding/earthing and bonding systems:

1. TIA/EIA

    a. TIA-942 Telecommunications Infrastructure Standard for Data Centers

    b. J-STD-607-D Commercial Building Grounding/Bonding Requirements

    c. TIA/EIA-606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

2. IEEE

    a. Std 1100 IEEE Recommend Practice for Powering and Grounding Electronic Equipment (IEEE Emerald Book)

3. Telcordia:

    a. NEBS 3 as defined for RBOC-CO compliance.

4. NFPA

    a. NFPA-70 National Electric Code (NEC)

B. Testing Procedures:

1. NEBS GR-63-CORE: Network Equipment-Building System Requirements: Physical Protection.

2. NEBS GR-1089-CORE: Electromagnetic Compatibility and Electrical Safety -- Generic Criteria for Network Telecommunications Equipment

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers, Grounding/Earthing Systems:

1. Panduit

2. Chatsworth

3. Harger

4. Burndy

5. Ortronics/Legrand

6. Erico

B. Acceptable Manufacturers, Telecommunications Bonding Busbars:

1. Panduit

2. Chatsworth

3. Harger

4. Burndy

5. Ortronics/Legrand

6. Erico

C. Acceptable Manufacturers, Rack Bonding Kits:

1. Panduit

2. Chatsworth

3. Harger

4. Burndy

5. Ortronics/Legrand

6. Erico

2.2 GROUNDING/EARTHING AND BONDING

A. General:

1. Conductors: Provide copper grounding/earthing conductors.

2. Lugs, grounding strips, and busbars: UL Listed.

3. Fabricate with premium quality tin-plated electrolytic copper, providing low electrical resistance while inhibiting corrosion.

4. Provide antioxidant for field- bonding connections.

5. Lugs: NEBS Level 3. Provide two-hole lugs with irreversible compression and inspection windows, certified for use in non-corrosive environments so that connections may be inspected for full conductor insertion.

6. Die index numbers: Embossed on compression connections to allow crimp inspection.

7. Cable assemblies: UL Listed and CSA Certified.

a. Cables: Green or green/yellow.

b. Jackets: UL Listed, VW-1 flame rated.

B. Telecommunications Bonding Backbone (TBB): A cable used to ground/earth PBB. Connect PBB to SBB; comply with J-STD-607-D guidelines and provide gauge not lighter than the following:

Table 1 – TBB/BBC/TBC conductor size vs length	
TBB Length in Linear meters (feet)	TBB Size (AWG)
Less than 4 (13)	6
4 - 6 (14 - 200)	4
6 - 8 (21 - 26)	3
8 - 10 (27 - 33)	2
10 - 13 (34 - 41)	1
13 - 16 (42 - 52)	1/0
16 - 20 (53 - 66)	2/0
20 - 26 (67-84)	3/0
26 - 32 (85 - 105)	4/0
32 - 38 (106 - 125)	250 kcmil
38 -46 (126 - 150)	300 kcmil
46 - 53 (151 - 175)	350 kcmil
53 - 76 (176 - 250)	500 kcmil
76 - 91 (251 - 300)	600 kcmil

Greater than 91 (301)	750 kcmil

C. Sizing the Telecommunications Bonding Conductor (TBC)

1. The TBC shall be, as a minimum, the same size as the largest TBB.

D. Sizing the Backbone Bonding Conductor (BBC)

1. The BBC shall be, as a minimum, the same size as the largest TBB to which it is connected.

E. Structural metal

1. The bonding conductor from the structural metal to the PBB or SBB shall be sized according to Table 1. Additionally, this conductor should be no smaller than any conductor that comprises the telecommunications bonding backbone system. Bonds to structural metal shall be made using listed exothermic welding, listed compression connections, or listed mechanical connectors and shall be accessible.

F. Telecommunications Equipment Bonding Conductor (TEBC): A cable used from the PBB or SBB to Rack and Rack Bonding Busbar (RBB) – minimum Size 6AWG.

G. Bonding Cable, Typical: For applications other than TBB, TEBC and BBC, provide gauge not lighter than the following:

Table 2- Cable Sizes for Other Grounding/Earthing Applications	
Purpose	Copper Code Cable Size
Aisle grounds (overhead or under floor) of the common bonding network	#2 AWG or larger (1/0 preferred)
Bonding conductor to each PDU or panel board serving the room.	Size per NEC 250.122 & manufacturer recommendations
Bonding conductor to HVAC equipment	6 AWG
Building columns	4 AWG
Cable ladders and trays	6 AWG
Conduit, water pipe, duct	6 AWG

2.3 COMPONENTS, KITS AND HARDWARE

A. Provide BICSI/J-STD-607-D telecommunications Primary Bonding Busbar PBB. Locate PBB at the telecommunications entrance room.

B. Provide BICSI/J-STD-607-D Telecommunications Bonding Conductor (TBC) from the telecommunications entrance room to the AC service entrance. Bonds to AC service entrance shall be made using listed exothermic welding, listed compression connections, or listed mechanical connectors and shall be accessible.

C. Provide BICSI/J-STD-607-D telecommunications Secondary Bonding Busbar (SBB) at typical telecommunications/equipment spaces throughout the building.

1. Provide additional SBB's as needed for number of termination points within each telecommunications/equipment space or upsize the SBB to a PBB.

2. Multiple SBB's within a room shall be bonded together with a conductor the same size as the TBB or with splice bars.

D. Provide BICSI/J-STD-607-D telecommunications Rack Bonding Busbar (RBB) at rack and cabinet locations.

E. Provide compression type two-hole lugs for connecting conductors to PBB, SBB and RBB.

PART 3 - EXECUTION

3.1 ROUTING TBB, TBC AND SBB

A. Route the TBB to each SBB in as straight a path as possible. The TBB should be installed as a continuous conductor, avoiding splices where possible. When more than one TBB is used, bond them together on the top floor and every third floor in-between with a conductor known as a Backbone Bonding Conductor (BBC). When sizing the BBC, it must be at least the same size as the largest TBB.

B. Bend The inside bend radius of telecommunications bonding conductors terminated at the primary bonding busbar (PBB) or secondary bonding busbar (SBB) shall have an inside bend radius of 200 mm (8 in). At other locations, bends in the bonding conductors should be limited to the greatest practical inside bend radius with a minimum bend radius of 10 times the bonding conductor diameter recommended. In all cases, the minimum bend radius angle shall be 90° or greater.

C. Avoid routing grounding/earthing conductors in metal conduits. If the grounding/earthing conductor must be routed through a metal conduit, bond each end of the conduit to the grounding/earthing conductor. Use grounding clamps to bond to the conduit and #6 AWG copper conductor to connect the grounding clamp to the TBB.

3.2 RACK GROUNDING/EARTHING

A. Bonding Equipment and Racks: Comply with BICSI/J-STD-607-D.

B. To provide electrical continuity between rack elements, use paint piercing grounding washers where rack sections bolt together, on both sides, under the head of the bolt, and between the nut and rack.

C. Utilize full-length rack ground strips attached to the rear of the side rail with thread-forming screws provided to ensure metal-to-metal contact.

D. Mount an electrostatic discharge (ESD) port kit, directly to the Rack Bonding Busbar. Mount a second electrostatic discharge (ESD) port kit directly to the vertical mounting rail of the rack in the front at approximately the same height. Use the thread-forming screws provided to form a bond to the rack.

E. When the equipment manufacturer provides a location for mounting a grounding connection, that connection shall be utilized. Use the appropriate jumper for the equipment being installed and the thread-forming screws provided in the kit.

F. Do not bond racks or cabinets serially.

G. Bond patch panels to racks using bonding screws.

H. Patch panels for shielded cabling shall be bonded to the telecommunications bonding system in accordance with manufacturer instructions

3.3 TESTING

A. Perform continuity testing measurements of the grounding system with resistance to not exceed 0.1 ohm between:

1. The PBB and the nearest grounding electrode.

2. Each SBB and the nearest grounding electrode.

3. Each SBB and pathway(s), rack(s), cabinet(s), and applicable equipment.

3.4 GROUNDING SYSTEM

A. Communications grounding system: Comply with ANSI/TIA-942 and ANSI/TIA-607-D.

B. Connection to Building ground/earth: Ensure connection is made by a licensed, electrical Installer, including installation and termination of the main bonding conductor to the building service entrance ground.

C. Bond PBB to building steel; ground/earth to electrical service ground. Comply with BICSI TDM Manual and ANSI/TIA-607-D guidelines.

D. Utilize UL listed exothermic two-hole lugs to make connections to the primary bonding busbar (PBB).

END OF SECTION 27 05 26

SECTION 27 05 28 TELECOMMUNICATIONS CABLING INFRASTRUCTURE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 REFERENCES

A. Building Industry Consulting Services International (BiCSi),"Telecommunications Distributions Methods Manual," Fourteenth Edition

B. ANSI/TIA-569-E, "Commercial Building Standard for Telecommunications Pathways and Spaces"

C. ANSI/TIA-606-C, “Administration Standard for the Telecommunications Infrastructure of Commercial Buildings”

D. ANSI/TIA-607-D, “Commercial Building Grounding/Bonding Requirements”

E. National Electrical Code (NEC), 2020 - National Fire Protection Agency (NFPA) 70

1.3 SUMMARY

A. Section Includes:

1. Cable management system.
2. Cabling identification products.
3. Backboards.
4. Telecommunications equipment racks and cabinets.
5. Telecommunications service entrance pathways.
6. Grounding.
7. Pathways.
8. Telecommunications mounting elements.
9. Multiuser telecommunications outlet assemblies.

B. Related Sections:

1. Division 27 05 26 “Grounding and Bonding for Communications Systems “for grounding conductors and connectors.

C. Bidding Requirements:

1. Bidder shall submit complete detailed proposals with line item cost representation for components and associated installation labor. Lump sum bids will not be accepted.

2. Bidders shall include as part of the bid response the following items:
   a. Installation schedule with proposed manpower assignments,
   b. Resumes for project manager and lead technician for this project.

3. Unspecified Equipment and Material: Any item of equipment or material not specifically addressed on the drawings or in this document and required to provide complete and functional Structured Cabling System shall be provided in a level of quality consistent with other specified items.

1.4 DEFINITIONS

A. AFC: Above Finished Ceiling Riser:

B. BICSI: Building Industry Consulting Service International.

C. EF: Entrance Facility

D. EMI: Electromagnetic interference.

E. HC: Horizontal Cross Connect

F. IDC: Insulation displacement connector.

G. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

H. LAN: Local Area Network.

I. MC: Main Cross-connect

J. NRTL: Nationally Recognized Testing Laboratory

K. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

L. RCDD: Registered Communications Distribution Designer.

M. TR: Telecommunications Room

1.5 SYSTEM DESCRIPTION

A. Provide a complete and functioning Structured Cabling System Infrastructure inclusive of all hardware to meet or exceed the performance features outlined in this document.

B. Communications equipment room shall provide the space to house the equipment for the backbone and horizontal cabling.

1.6 SUBMITTALS

a. Cover Sheet
   1) Include name of supplying contractor and project name.
   2) Include submittal and revision number.

b. Detailed Bill of Materials
   1) Include a listing of component quantities, equipment manufacturers, model numbers, and descriptions of each component being supplied and the specification paragraphs or drawing sheets that correspond to each product.
   2) The bill of materials shall include page numbers for each product data sheet and be index referenced within the PDF file so that each product name is clickable, linked to the first page of the corresponding product data.
   3) Failure to provide this information will result in the rejection of submittals.
c. Product Data
   1) Include a catalog sheet per product of equipment listed in the Detailed Bill of Materials, in the exact order as the Detailed Bill of Materials. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include an image of the product.
   2) Photocopy duplications of the manufacturer's original equipment catalog sheets will be allowed as long as they provide adequate clarity of both the printed word and graphics/pictures.
   3) If more than one product is shown on the catalog sheet the intended product must be denoted by either an arrow or highlight.
d. Prequalification Certificate
   1) Copy of the installing technician(s) certificate of completion from the manufacturer's training school for the equipment being provided.
e. Submittal shall be a single PDF file.
   1) Partial submittals, or submittals comprised of multiple PDF files, will be rejected.

B. Shop Drawings are to be submitted on project standard full size and bound. Each shop drawing set is to include the below in the following order:

1. Title Sheet.
   a. Containing, at a minimum, a list of all drawings in the set and a symbols legend defining each symbol used in the package.

1. Telecommunications Room Details.
   a. Plan Details of infrastructure and room fittings with clearances, Elevation details of wall fields and rack details.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer and manufactures certified installer, who shall be present at all times when Work of this Section is performed at Project site. One half of remainder of the crew shall be at a minimum Registered Technicians by manufacture as part of their Certified Installer Program.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Telecommunications Pathways and Spaces: Comply with ANSI/TIA-569-E.

D. Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, 2017 ANSI/ANSI/TIA–606-C.

E. Grounding: Comply with ANSI-J-STD-607-D.

F. NFPA 70 – National Electric Code, latest edition

G. BICSI – Telecommunications Distribution Methods Manual, Fourteenth Edition

H. NEMA – VE-1 – Metal Cable Tray Systems, 2017

I. NEMA – VE-2 – Metal Cable Tray Installation Guidelines, 2013

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install equipment frames and ladder racking until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.9 COORDINATION

A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.

2. Record agreements reached in meetings and distribute them to other participants.

3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

B. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

C. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

D. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PATHWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, and are limited to, the following:

1. Basis of design: nVent Caddy

2. Approved equals by:
   a. Eaton/B-line
   b. Hilti Inc.

B. General Requirements: Comply with TIA/EIA-569-E.

C. Cable Support: NRTL labeled. Cable support brackets in Telecommunications Rooms shall be designed to prevent degradation of cable performance and pinch points that could damage cable.

D. Provide bend limiters, if not built into the cable support, to maintain cable type bend radius whenever cable exists pathways or makes transition between two pathways.

E. Non-continuous cable supports shall be used in any area above the finished ceiling where cable tray is not available.

F. Adjustable non-continuous cable support slings shall be used in corridors as outlined on “TA”

G. Non-continuous cable supports

1. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

2. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables; cULus Listed.

3. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.

4. Non-continuous cable supports sized 1 5/16” and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.

5. Non-continuous cable supports shall have an electro-galvanized or G60 finish and shall be rated for indoor use in non-corrosive environments.

6. Non-continuous cable supports shall be ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64, CAT21SS, CAT32SS, CAT64SS; CAT-CMTM Double J-Hook CAT100CM; CAT-CMTM U-hook series CAT200CMLN, CAT300CMLN; and CAT-CMTM retainer CATRT200CM, CATRT300CM or approved equal.

H. Adjustable non-continuous cable support sling

1. Constructed from steel and woven laminate; sling length can be adjusted to hold up to 425 4-pair UTP; rated for indoor use in non-corrosive environments. Rated to support Category 5 and higher cable, or optical fiber cable; cULus Listed.

2. Adjustable non-continuous cable support sling shall have a static load limit of 100 lbs.

3. Adjustable non-continuous cable support sling shall be suitable for use in air handling spaces.

4. If required, assemble to manufacturer recommended specialty fasteners including beam clips, flange clips, C and Z purlin clips.

5. Acceptable products: ERICO CADDY CableCat™ CAT425; or approved equal.

I. Non-continuous cable support assemblies from drop wire/ceiling

1. Fastener to wire/rod with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.

2. Acceptable products: ERICO CADDY CAT124Z34, CAT126Z34, CAT214Z34, CAT216Z34, CAT324Z34 or CAT326Z34; or approved equal.

J. Non-continuous cable support assemblies from beam, flange

1. Fastener to beam or flange with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.

2. Acceptable products: ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY beam clamps and CADDY flange clips; or approved equal.

K. Non-continuous cable support assemblies from C & Z Purlin

1. Fastener to C or Z purlin with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus listed.

2. Acceptable products: ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY Purlin hangers; or approved equal.

L. Non-continuous cable support assemblies from wall, concrete, or joist

1. Fastener to wall, concrete, or joist with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus listed.

2. Acceptable products: ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64, with CADDY angle bracket; or approved equal.

M. Non-continuous cable support assemblies from threaded rod

1. Fastener to threaded rod with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments, cULus Listed.

2. The multi-tiered support bracket shall have a static load limit of 300 lbs.

3. U-hooks and Double J-hook shall attach directly to threaded rod using standard nuts.

4. Acceptable products: ERICO CableCatTM J-hook, CAT12, CAT21, CAT32, CAT64 with CADDY CATHBA series; CAT-CMTM Double J-hook CAT100CM, CAT-CMTM Direct mount U-hook CAT200CMLN, CAT300CMLN; or AFAB series; or approved equal.

N. Raised floor non-continuous cable support assemblies

1. Fastener to raised (access) floor pedestal with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments; cULus Listed.

2. Acceptable products: ERICO CADDY CAT12CD1B, CAT21CD1B or CAT32CD1B; CAT64CD1B; or approved equal.

O. Cantilever-Mounted cable supports

1. U-hook shall be able to be assembled to a wide variety of wall mount brackets.

2. Spacing of individual U-hooks as needed, max of 4’ to 5’ apart.

3. U-hooks may have the optional attachment of a cable roller for ease in pulling cables.

4. Acceptable products: ERICO CAT-CMTM U-hooks CAT200CMLN, CAT300CMLN: CAT-CM roller assemblies CATRL200CM, CATRL300CM; CATWMCM bracket; or approved equal.

2.3 METAL CONDUIT AND TUBING

A. Manufacturers:

1. AFC Cable Systems, Inc.

2. Alflex Inc.

3. Anamet Electrical, Inc.; Anaconda Metal House.

4. Electri-Flex Co.

5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.

6. O-Z Gedney; Unit of General Signal.

7. Wheatland Tube Co.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. EMT and Fittings: ANSI 80.3.

1. Fittings: Set-screw or compression type.

E. FMC: Zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket.

G. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.4 METAL WIREWAYS

A. Manufacturers:

1. Hoffman.

2. Square D.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1 for interior & NEMA 4 for exterior.

C. Fittings and Accessories: include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Flanged-and-gasketed type or As indicate.

F. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.

B. Manufacturers:

1. Airey-Thompson Sentinel Lightning; Wiremold Company (The).

2. Thomas & Betts Corporation.

3. Walker Systems, Inc.; Wiremold Company (The).

4. Wiremold Company (The); Electrical Sales Division.

C. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers:

1. Coooper Crouse-Hinds; Div. Of Cooper Industries, Inc.

2. Emerson/General Signal; Appleton Electric Company.

3. Hoffman.

4. Hubbell, Inc.; Killark Electric Manufacturing Co.

5. O-Z/Gedney; Unit of General Signal

6. RACO; Division of Hubbell, Inc.

7. Robroy Industries, Inc.; Enclosure Division.

8. Spring City Electrical Manufacturing Co.

9. Thomas & Betts Corporation.

10. Walker Systems, Inc.; Wiremold Company (The)

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Floor Boxes: Cast metal, fully adjustable, rectangular.

E. Small sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.

H. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

I. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

J. FACTORY FINISHES

1. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard paint applied to factory assembled surface raceways, enclosures, and cabinet before shipping.

2.7 FIRE STOP CABLE PASS-THRU SLEEVES

A. Manufacturers: Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, and are limited to, the following:

1. Basis of design: Specified Technologies Inc.

2. Approved equal by:
   a. 3M Corporation
   b. Hilti Corporation
   c. Wiremold- Legrand Corporation

B. Fire Rated Cable Pathways: STI EZ-PATH Brand device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:

1. Specified Technologies Inc. (STI) EZ-PATH Series 44 Fire Rated Pathway

2. Specified Technologies Inc. (STI) EZ-PATH Series 33 Fire Rated Pathway

C. Fire stop sleeves located in the floor of each TR shall be quantity as shown on contract drawings STI EZ-path MAX Series 44 cast in concrete.

D. Horizontal cable pathway locations shall be quantity as shown on contract drawings.

2.8 FIRE STOP CABLE MODULAR FLOOR GRID SYSTEM

A. Manufacturers: Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, and are limited to, the following:

1. Basis of design: Specified Technologies Inc.

2. Approved equal by:
   a. Hilti Corporation
   b. 3M Corporation

B. Fire stop sleeves located in the floor of TR's shall be STI EZ PATH Series 44 Modular Grid System quantities as shown on contract drawings.

1. Product EZDG444 single slot grid complete with EZ-PATH Series 44 modules.

2. Product EZG844 with EZD444MB pathway modules.

3. Product EZG1644 with EZD444MB pathway modules.

2.9 NON-RATED CABLE PASS-THRU SLEEVES

A. Manufacturers: Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, and are limited to, the following:

1. Basis of design: Specified Technologies Inc.

2. Approved equal by:
   a. 3M Corporation
   b. Hilti Corporation
   c. Wiremold- Legrand Corporation

B. Non-Rated Cable Pathways: STI EZ-PATH Brand device modules The smoke and acoustical pathway shall contain a built-in sealing system and shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed, or retrofitted without the need to remove or reinstall acoustical materials. The following products are acceptable:

1. Specified Technologies Inc. (STI) EZ Path® Series 44 NEZ Smoke and Acoustical Pathway

2. Specified Technologies Inc. (STI) EZ Path® Series 33 NEZ Smoke and Acoustical Pathway

3. SpecSeal® Smoke 'N' Sound Smoke and Acoustical Sealant
   a. SNS120W 20 Oz Sausage - 36 cu in (592 ml)

b. SNS129W 730573111529 29 Oz Tube - 52 cu in (858 ml)
c. SNS105W 730573111543 5 Gallon Pail - 1,155 cu in (19.0 L) (White)

C. Horizontal cable pathway locations greater than 20 cables fire stop sleeves shall be STI EZ-Path series 33 or 44 as needed for pathway cable capacity

D. Horizontal cable pathway locations fewer than 20 cables EMT sleeve with mineral or ceramic fiber stuffing insulation and smoke/acoustical Sealant.

E. Fill ratio for fire stop EMT sleeves shall not exceed 20% fill capacity.

2.10 GROUNDING

A. Comply with requirements in Division 27 05 26 “Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-D.

2.11 LADDER RACK, SUPPORTS, AND ACCESSORIES

A. Ladder Rack (Universal Cable Runway)

1. Ladder rack shall be manufactured from 3/8” wide by 1-1/2” high tubular steel with .065” wall thickness.

2. Ladder rack (side stringers) will be 9’-11½” long. Cross members will be welded in between stringers on 12” centers beginning 5-3/4” from one end so that there are 10 cross members per ladder rack. There will be 10-1/2” of open space in between each cross member.

3. Ladder rack will be delivered individually boxed, and available in the multiple widths.

4. Finish shall be epoxy-polyester hybrid powder coat (paint) black in color.

5. Design Make: Chatsworths Products, Inc. (CPI), Universal Cable Runway: Part Number 10250-712, Universal Cable Runway, 12” Wide, Black 10250-718, Universal Cable Runway, 18” Wide, Black or approved equal.

6. Design Make: Chatsworths Products, Inc. (CPI), Universal Cable Runway: Part Number 10250-724, Universal Cable Runway, 24” Wide, Black placed in vertical positions or approved equal.

B. Ladder Rack Splices

1. Splice kits will provide a method of mechanically connecting ladder rack sections and turns together end-to-end or side-to-end to form a continuous pathway for cables.

2. Grounding kits will provide a method of bonding ladder rack sections and turns together that is independent of the pathway splices. The grounding kit should be constructed of UL Listed components. The preferred solution is a #6 AWG green insulated stranded copper conductor connected on both ends to ladder rack using two-hole compression lugs and stainless steel hardware.

3. Splices (splice plates) will be manufactured from steel. Splice, grounding and insulator bar kits will include installation hardware.

4. Finish (of splice plates and hardware) shall be zinc plate in the color(s) specified below. Colors are applied as a chem. film over the zinc plate.

5. Design Make: Chatsworths Products, Inc. (CPI), Cable Runway Splices or approved equal.

C. Ladder Rack Supports

1. Supports will be sized to match the width of the ladder rack that is supported. Some supports will work with all widths of ladder rack.

2. Each support will include a means of securing ladder rack to the support.

3. Supports will be manufactured from steel or aluminum.

4. Finish shall be epoxy-polyester hybrid powder coat (paint) in the color(s) specified below or zinc plate with a gold chem. finish specified gold. Included hardware shall be zinc plated with a gold chem. finish.

5. Design Make: Chatsworths Products, Inc. (CPI), Cable Runway Supports or approved equal.

D. Ladder Rack Accessories

1. Cable straps used for attaching cable bundles to the ladder rack cross members must be reusable with a hook and loop-style closure, at least ¾” wide, and sized for cable bundles that are 2”, 3” or 4” in diameter.

2. Cable retaining posts used to keep cable from falling off of the side of the ladder rack shall be manufactured from 1” by ½” tubular steel with .065” wall thickness. Cable retaining posts will be 8” high and will attach to the side stringer of the ladder rack with included hardware. The top of the cable retaining posts will be fitted with a rubberized end cap to protect cables.

3. End caps used to cover the ends of ladder rack will be manufactured from a black fire-retardant rubberized material. End caps will be sized for 3/8” wide by 1-1/2” high side stingers and will be sold in pairs.

4. End closing kits used to cover the end of ladder rack will be manufactured from 3/8” wide by 1-1/2” high tubular steel with .065” wall thickness. Kits will consist of a bar cut to match the width of the ladder rack and the hardware required to attach the bar to the end of a length of ladder rack.

5. Radius drops used to create a radius to form cables over as the cables exit or enter the ladder rack will be manufactured from aluminum extrusion. The extrusion will be formed in a 90° arc with a minimum bend radius of 3”. Radius drops will attach to either the side stringer or the cross member of the ladder rack using a clevis pin. Radius drops will include 1-1/2” high cable spools that attach to the top of the radius drop to guide cables.

6. Movable cross members used to support cross member radius drops in between welded cross members on ladder rack will be manufactured from 3/8” by 1-1/2” aluminum bar. Movable cross members will attach to ladder rack at the side stringers with included hardware so that the location of the movable cross member can be adjusted. Moveable cross member will support a cross member radius drop.

7. Cable spools used to separate ladder rack into multiple cable pathways will be made from a black flame retardant ABS. Cable spools will attach to the cross members with a clip that allows the width of the ladder rack to be divided into any proportion. The spools will be 3.94” tall, with a 1.94” diameter top, and a body that tapers from .88” (diameter) at the top to .62” (diameter) at the bottom.

8. Auxiliary support brackets used to support cables that should be physically separated from the cables in the ladder rack will be made from 1/8” x 1” steel bar. The bracket will be L-shaped and will attach to the side stringer of the ladder rack. The bracket will hang below the ladder rack a minimum of 4”. The bracket support surface will be 4” long. The bracket will be zinc plated with a gold chem. finish.

9. Touch-up paint used on ladder rack and ladder rack system components will be color-matched to the finish on the ladder rack or component. A spray on and brush on option will be available.

10. Unless otherwise noted, finish on all metal components shall be epoxy-polyester hybrid powder coat (paint) black in color. Hardware will be zinc plated with a gold chem. finish.

11. Design Make: Chatsworths Products, Inc. (CPI), Cable Runway Accessories or approved equal.

2.12 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches A-C Grade.

1. Provide materials that comply with performance requirements in AWPA C27. Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

2. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5516, for plywood.

B. All 4 walls shall be covered with rigidly fixed 3/4 inch A-C plywood with the A grade side facing outward. The plywood shall be void free and extend from 6 inches above the finished floor (AFF) to 102 inches AFF and capable of supporting the attached equipment.

C. Comply with requirements in Division 09 Section “Paints and Coatings" for fire-retardant plywood.

2.13 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-C and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Division 16 Section "Electrical Identification."

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Comply with TIA/EIA-569-E for pull-box sizing and length of conduit and number of bends between pull points.

B. Outdoors:

1. Exposed: Rigid Steel

2. Concealed: Rigid Steel

3. Underground, Single Run: RNC.

4. Underground, Grouped: RNC.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

6. Boxes and Enclosures: NEMA 250, Type 4.

C. Indoors:

1. Exposed: RNC.

2. Concealed: EMT.

3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.

4. Damp or Wet locations: Rigid steel conduit.

5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
   a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel

D. Minimum Raceway Size: 3/4-inch trade size (DN 21).

E. Raceway Fittings: Compatible with raceways and suitable for use and location.

F. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 CONDUIT AND RACEWAY INSTALLATION

A. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

1. Support raceways as specified in Division 16 Section “Electrical Supports.”

2. Install temporary closures to prevent foreign matter from entering raceways.

C. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

D. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

E. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

F. Raceways Embedded in Slabs: Not permitted, unless indicated otherwise on the drawings. Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.

G. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.

2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

H. Join raceways with fittings designed and approved for that purpose and make joints tight.

1. Use insulating bushings to protect conductors.

I. Tighten set screws of threadless fittings with suitable tools.

J. Terminations:

1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install knockouts with dished part against box. Use two locknuts, one inside and one outside box.

2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90 kg) tensile strength. Leave at least 12 inches (300 mm) of slace at each end of pull wire. Pulling strings used for AV outlets and raceways shall have measuring indication on both ends.

L. Telephone and Signal System Raceways, 2-inch trade size (DN 53) and smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where otherwise required by NFPA 70.

N. Stub-up Connections: Exntend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

O. Flexible Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

P. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

Q. Trim after installation to fit flush with finished floor surface.

R. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 INSTALLATION OF PATHWAYS

A. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.

2. Install cable trays to route cables if conduits cannot be located in these positions.

3. Secure conduits to backboard when entering room from overhead.

4. Extend conduits 3 inches (76 mm) above finished floor.

5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.4 NON-CONTINUOUS CABLE SUPPORTS

A. Installation and configuration shall conform to the requirements of the current revision levels of ANSI/ EIA/TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer’s installation instructions.

B. Do not exceed load ratings specified by manufacturer.

C. Adjustable non-continuous support sling shall have a static load limit of 100 lbs.

D. Follow manufacturer’s recommendations for allowable fill capacity for each size non-continuous cable support.

3.5 WIRING METHODS

A. Wiring Method: Install cables in raceways, J hooks, and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables accessible ceilings, walls, and floors except in unfinished spaces.

B. Install plenum cable in environmental air spaces, including plenum ceilings.

C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

D. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

E. Provide equipment frames and ladder racking as outlined in telecommunications series drawings.

3.6 INSTALLATION TELECOMMUNICATIONS ROOMS

A. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

B. Bond the shield of any shielded cable to the grounding bus bar in communications rooms and spaces.

C. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

D. Ladder Rack

1. Provide all components of the ladder rack system (ladder rack, turns, splices, supports, and accessories) from a single manufacturer.

2. Ladder rack shall be installed with side stringers facing down so that the ladder forms an inverted U-shape and so that welds between the stringers (sides) and cross members (middle) face away from cables.

3. Ladder rack shall be secured to the structural ceiling, building truss system, wall, floor or the tops of equipment racks and/or cabinets using the manufacturer’s recommended supports and appropriate installation hardware and methods as defined by local code or the authority having jurisdiction (AHJ).

4. Ladder rack splices will be made in mid-span, not over a support, with the manufacturer’s recommended splice hardware.

5. Ladder rack shall be supported every 5’ or less in accordance with TIA-569-E. Ladder rack shall be supported within 2’ of every splice and within 2’ on both/all sides of every intersection. Support ladder rack within 2’ on both sides of every change in elevation. Support ladder rack every 2’ when attached vertically to a wall.

6. Heavy-duty splices are recommended for ladder rack in excess of 18” width (18” wide ladder rack). Heavy-duty splices are required for any splice formed in the vertical orientation including changes in elevation formed using vertical-to-horizontal 90° turns or horizontal-to-vertical 90° turns. Use heavy-duty splices to secure all overhead turns to the overhead horizontal pathway(s).

7. When the pathway is overhead, ladder rack shall be installed with a minimum clearance of 12” above the ladder rack. Leave a minimum of 12” in between ladder rack and ceiling/building truss structure. Leave a minimum of 3” in between ladder rack and the tops of equipment racks and/or cabinets. Multiple tiers of ladder rack shall be installed with a minimum clearance of 12” in between each tier of ladder rack. When located above an acoustical drop ceiling, leave a minimum of 3” clearance between the top of the drop ceiling tiles and the bottom of the ladder rack.

8. When installed under a raised floor, ladder rack shall be installed with a minimum 3” clearance between the top of the ladder rack and the bottom of the floor tiles or floor system stringers, whichever is lower in elevation. Maintain a 3” clearance between ladder racks wherever ladder racks cross.

9. Within each telecommunications room, ladder rack should be bonded together, electrically continuous, and bonded to the TGB, unless otherwise noted in the specifications and contract documents. Ladder rack and turns shall be bonded across each splice with a bonding kit. Ladder rack shall be bonded to the Telecommunications Grounding Busbar (TGB) using an approved ground lug on the ladder rack and a minimum #6 grounding wire or as recommended by the AHJ. Remove paint from the ladder rack where bonding/ground lugs contact the ladder rack so that the lug will contact bare metal. Use antioxidant joint compound in between the bare metal on the ladder rack and ground lug. Use antioxidant joint compound in between the bus bar and the ground lug. Verify continuity through the bonds at splices and intersections between individual ladder rack sections and turns and through the bond to the TGB.

10. The quantity of cables within the ladder rack will not exceed a whole number value equal to 50% of the interior area of the ladder rack divided by the cross-sectional area of the cable. The interior area of ladder rack will be considered to be the width of the ladder rack multiplied by a height of 2”, unless cable retaining posts are added to the ladder rack. The interior area of ladder rack equipped with cable retaining posts will be considered to be the width of the ladder rack multiplied by a height of 6”. Actual cable fill for ladder rack that is not equipped with cable retaining posts will not exceed 2” in height. Actual cable fill for ladder rack equipped with cable retaining posts will not exceed 6” in height.

11. The combined weight of cables within the ladder rack will not exceed the stated load capacity of the ladder rack as stated in the manufacturer’s product specifications or load/design tables.

12. Cables (cable bundles) will be secured to the cross members of ladder rack with ¾” wide reusable straps. Straps are not required when ladder rack is equipped with cable retaining posts.

13. Add 8” high cable retaining posts to the open sides of ladder rack when cable fill exceeds 2” in height or when cable bundles cannot be secured directly to the ladder rack cross members with a strap. Cable fill within any ladder rack should not exceed 6” in height.

14. When a single ladder rack supports different types of cable media, the cable media will be separated within the pathway by cable spools that attach to the cross members on the ladder rack. Treat each type of cable media and divided area of the ladder rack separately when determining cable fill limits.

15. Use a radius drop to guide cables wherever cable exits overhead ladder rack to access a rack, frame, cabinet or wall-mounted rack, cabinet or termination field. If necessary, provide

a moveable cross member also to attach and align the radius drop in between the welded cross members of a ladder rack.

16. Cover the exposed ends of cable runway that do not terminate against a wall, the floor or the ceiling with end caps or an end closing kit.

17. Use auxiliary support brackets that attach to the side stringer of the ladder rack to support interconnect cabling (patch cords, equipment cords, jumper cords) that is routed between racks using the ladder rack. Auxiliary support brackets can be used to support other conductors that should be physically separated from cables within the ladder rack as defined by local code or the authority having jurisdiction (AHJ).

18. Whenever possible, maintain a 2’ separation between ladder rack used for communications cables and pathways for other utilities or building services.

19. Provide touch-up paint color-matched to the finish on the ladder rack and correct any minor cosmetic damage (chips, small scratches, etc.) resulting from normal handling during the installation process prior to delivery. If a component is cosmetically damaged to the extent that correction in the field is obvious against the factory finish, the component will be replaced with a new component finished from the factory. If a component is physically damaged due to mishandling or modification during the installation process, it shall not be used as part of the ladder rack system.

3.7 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."

B. General: Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.

C. Install EZ Path Series 44 in Telecommunications Rooms as shown on contract drawings.

D. Install EZ Path or EMT sleeve where horizontal cables penetrate a fire or smoke rated wall.

E. Manufacturer’s Instructions: Comply with manufacturer’s instructions for installation of firestopping products.

F. Comply with TIA/EIA-569-E, "Firestopping."

G. Comply with BICSI TDMM, "Firestopping Systems" Article.

H. Any penetrations created for the passage of telecommunications shall be fire stopped.

I. Install fire stop units as per manufactures Instructions.

3.8 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with requirements in division 270526 “Grounding and Bonding for Communications Systems” for grounding conductors and connectors.

C. Comply with ANSI-J-STD-607-D.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.9 IDENTIFICATION

A. Identify system components complying with TIA/EIA-606-C. Comply with requirements for identification specified in Division 16 Section "Electrical Identification."

B. Comply with requirements in Division 9 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

3.10 REPAIR/RESTORATION

1. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of substantial completion.

2. Protect adjacent surfaces. Repair damage to any surfaces occurring as a result of the work of this Section. Repair of surfaces shall include re-painting in accordance with Division 09 Section “Painting.”

3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.11 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

B. At the completion of the System, restore aspects of the project site to its former condition. Remove daily waste and excess materials, rubbish debris, tools and equipment resulting from or used in the services provided under this Contract. Remove trash from all work areas. Do not use dumpsters or trash disposal without prior approval.

END OF SECTION 27 05 28

SECTION 27 05 28.36 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Continuous, rigid, welded steel wire mesh cable tray system used in industrial, commercial, and telecommunications applications

B. Cable tray systems are defined to include, but are not limited to, straight sections, supports and accessories.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

A. Related Sections:

1. Comply with Section 27 10 00, “Telecommunications Structured Cabling,” for voice and data cabling associated with system panels and devices.

B. Bidding Requirements:

1. Submit complete detailed proposals with line item cost representation for components and associated installation labor. Lump sum bids will not be accepted.

2. Include as part of the bid response the following items:
   a. Installation schedule with proposed manpower assignments.
   b. Resumes for project manager and lead technician for this project.

3. Review associated electrical, audiovisual, and telecommunications infrastructure drawings to verify that necessary conduit and boxes will be provided. Understand and coordinate shared infrastructure locations for AV and voice/data outlets. No additional infrastructure to support the telecommunications cabling systems (inside plant/outside plant) will be provided. Any discrepancies with the identified infrastructure to support these systems should be questioned in the form of a request for information (RFI) during the bidding process. Be responsible for any additional infrastructure requirements after receipt of contract for this project.

4. No wiremold or surface mounted raceways shall be approved on this project except where explicitly identified.

1.4 REFERENCES

A. IEC 61537 (2006) – Cable Tray Systems and Cable Ladder Systems for Cable Management

B. NEMA VE 1-2017/CSA C22.2 No. 126.1-17 – Metal Cable Tray Systems

C. ANSI/NFPA 70 – National Electrical Code (NEC)

D. TIA 569-D (2015) – Commercial Building Standard for Telecommunications Pathways & Spaces

E. ASTM A 510 - Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel

F. ASTM A 380 – Specification for Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems

G. ASTM B 633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel

H. ASTM A 123 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

I. ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

J. Norm NF/A 91-131 for Galvanized Steel

K. Norm NF/EN 12-329 for Electrozinc Coating

L. Norm NF/EN/ISO 14-61 for Hot-Dipped Galvanized Steel

M. Norm NF 10-088-2 for Stainless Steel

1.5 SYSTEM DESCRIPTION

A. This section outlines the performance for the noted cable tray support systems, as indicated on the low voltage drawings. The tray system shall provide a common raceway for telecommunications cable into and out of the Telecommunications Rooms (TR). Cable tray systems shall also be installed above finished ceiling in the common area hallways that are located on all floors of the building. The common area cable tray is intended to support telecommunications cabling from any of the station cable wall/floor outlet locations on any floor. Each station cable wall/floor outlet shall have a configuration of conduit pipe run to the tray system to support the aforementioned station cabling. It is intended to have this tray system transition (via a Cable Dropout or Runway Radius Drop) into the ladder tray installed above the noted equipment racks within the TR's.

1.6 DESIGN REQUIREMENTS

A. Maximum Deflection between Supports: L/240

1.7 SUBMITTALS

A. Related Sections

1. Comply with requirements of Section 01 33 00, "Submittal Procedures."

B. Submittal Data

1. Submittal data is to be submitted as a complete, single digital file. All documents shall be clearly legible. Each submittal shall contain the below in the following order:
   a. Cover Sheet
      1) Include name of supplying contractor and project name.
      2) Include submittal and revision number.

b. Detailed Bill of Materials
   1) Include a listing of: component quantities, equipment manufacturers, model numbers, descriptions of each component being supplied, and the specification paragraphs or drawing sheets that correspond to each product.
   2) The bill of materials shall be index referenced within the PDF file so that each product name is clickable, linked to the first page of the corresponding product data.
   3) Failure to provide this information will result in the rejection of submittals.
c. Product Data
   1) Include a catalog sheet per product of equipment listed in the Detailed Bill of Materials, in the exact order as the Detailed Bill of Materials. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include an image of the product.
   2) Photocopy duplications of the manufacturer's original equipment catalog sheets will be allowed if they provide adequate clarity of both the printed word and graphics/pictures.
   3) If more than one product is shown on the catalog sheet the intended product must be denoted by either an arrow or highlight. All optional components and selections shall be clearly indicated.
d. Prequalification Certificate.
   1) Copy of the installing technician(s) certificate of completion from the manufacturer's training school for the equipment being provided.
e. Manufacturer Qualifications
   1) Submit manufacturer's certification indicating ISO 9002 quality certified.
f. Design Calculations
   1) Verify loading capacities for supports.
g. Submit Factory-certified test reports of specified products, complying with IEC 61537, NEC, and NEMA VE 1/CSA C22.2 No. 126.1.

C. Shop Drawings

1. Prior to fabrication submit contractor-generated drawings for approval for all supplied systems. These drawings shall include, but are not limited to, the following:
   a. Title Sheet with sheet index and symbols legend
   b. Coordination Drawings: Include floor plans and sections drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural and mechanical elements. Data presented on these drawings are as accurate as preliminary surveys and planning can determine. Field verification of all dimensions, routing, etc., is directed.
   c. Cable Tray Drawings: Submit drawing indicating materials, finish, dimensions, and accessories. Show layout, support, and installation details.

2. Drawings should be at project standard scale and clearly legible.

3. Resubmission of contract drawings does not constitute a complete shop drawings submittal and is unacceptable. Such submittals will be rejected.

D. Form

1. Submit all materials for review as described above, specifically referenced to the specification paragraph number (where applicable).
   a. Submit all drawings on sheets of one size, preferably the project standard size.
   b. On submittal drawings, maintain 3/32" minimum lettering height. Submittals with text less than 1/16" in height may be rejected.

2. Partial Submittals may be rejected. If submitted individually and each in its entirety, the following submittals shall not be considered partial:
   a. Personnel
   b. Milestones
   c. Conduit Verification Statement and Notifications
   d. Rigging and Mounting Drawings
   e. As-Built Documentation

3. Product Data and shop drawings must be submitted together in order to be reviewed.

1.8 QUALITY ASSURANCE

A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

B. Manufacturer Qualifications: ISO 9002 quality certified

C. Comply with NFPA 70. National Electrical Code, Article 392: Cable Trays; provide UL Classification and labels.

D. Provide ETL test documentation showing cable compression/deformation testing.

1.9 COORDINATION

A. Coordinate layout and installation of cable tray with other installations.

1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect.

B. Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products will not be installed. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials will be unpacked and dried before storage. Protect materials and finishes during handling and installation to prevent damage

C. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturers: Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, and are limited to, the following:

1. Cablofil, Inc. (Basis of design)

2. NVent/WBT

3. Bline

4. Chatsworth

5. Snake Tray

6. approved equal.

2.2 CABLE TRAY SYSTEM

A. Description: Cablofil EZ Tray continuous, rigid, welded steel wire mesh cable tray system

1. Mesh System: Permits continuous ventilation of cables and maximum dissipation of heat

2. Safety Edge: Continuous safety edge T-welded wire lip

3. Wire Mesh: Welded at all intersections

B. UL Classification: Straight sections 4 x 8, 12, 18 and 24 inches (108 x 200, 300, 450, and 600 mm), UL classified. Width of tray shall be determined based on not exceeding industry standards for fill ratios.

C. Material: Carbon steel wire, ASTM A 510, Grade 1008. Wire welded, bent, and surface treated after manufacture

D. Finish for Carbon Steel Wire: Finish applied after welding and bending of mesh

1. Electro-Plated Zinc Galvanizing: ASTM B 633, Type III, SC-1

2. Hot-Dip Galvanizing: ASTM A 123

E. Nominal Dimensions:

1. Mesh: 2 x 4 inches (50 x 100 mm)

2. Straight Section Lengths: 80 inches (2,000 mm) and 118 inches (3,000 mm)

3. Width: Cable tray widths shall be selected based on cable density. No tray shall exceed 50% manufacturer’s stated capacity at time of initial installation.
   a. 2 inches (50 mm)
   b. 4 inches (100 mm)
   c. 6 inches (150 mm)
   d. 8 inches (200 mm)
   e. 12 inches (300 mm)
   f. 18 inches (450 mm)
   g. 24 inches (600 mm)

4. Depth: 4 inches (108 mm)

5. Wire Diameter: 0.177 inch (4.5 mm), minimum

F. Fittings: Field fabricated in accordance with manufacturer's instructions from straight sections

G. Support System: Standard

1. Wall Installation: CS Bracket. Maximum tray width of 12 inches (300 mm)

2. Trapeze Mounting to Ceilings: CS Profile. Maximum tray width of 18 inches (450 mm)

3. Ceiling Installation: CSC Bracket. Maximum tray width of 12 inches (300 mm)

4. Fasteners: As required by tray widths. Furnished by manufacturer.

H. Support System: Caloric FAS System

1. Floor and Wall Installation: FAS Profile

2. Wall Installation:
   a. FAS Universal Bracket. Maximum tray width of 24 inches (600 mm)
   b. FAS L Bracket. Maximum tray width of 12 inches (300 mm)

3. Ceiling Installation: FAS C Bracket. Maximum tray width of 12 inches (300 mm)

4. Fasteners: Not required

I. Hardware: Hardware, including splice connectors and support components, shall be furnished by the manufacturer.

2.3 ACCESSORIES

A. Shielding Divider Strips: Divider strips to follow contour of cable tray run for shielding to run power and control cables in same tray. Pre-galvanized steel, [4 x 1-1/2 inches (108 x 30 mm)]

B. Fittings: Provide tees, crosses, risers, elbows, radius tees, and other fittings as indicated, of the same materials and finishes as cable tray.

C. Grounding: Provide GNDSB grounding lugs for attachment on tray of continuous ground conductor fixing system.

2.4 FIRE STOP CABLE PASS-THRU SLEEVES

A. Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, and are limited to, the following:

1. Basis of design: Specified Technologies Inc.

2. Approved equal by:
   a. 3M Corporation
   b. Hilti Corporation
   c. Wiremold- Legrand Corporation

B. Fire Rated Cable Pathways: Provide STI EZ-PATH ™ Brand device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill. The following products are acceptable:

1. Specified Technologies Inc. (STI) EZ-PATH Series 44 Fire Rated Pathway

2. Specified Technologies Inc. (STI) EZ-PATH Series 33 Fire Rated Pathway

PART 3 - EXECUTION

3.1 EXAMINATION

A. Exam areas to receive cable management system. Notify the Architect of conditions that would adversely affect the installation or subsequent utilization of the system. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install cable tray level and plumb according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.

B. Install cable management system at locations indicated on the drawings and in accordance with manufacturer's instructions. Install the cable tray system directly above the racks positioned within the space to allow for ease in cable management to and from the racks. Provide firestopping at penetration into/out of all telecommunications rooms.

C. Load Span Criteria: Install and support cable management system in accordance with span load criteria of L/240.

D. Cutting:
   a. Cut cable tray wires in accordance with manufacturer’s instructions.
   b. Cable tray wires must be cut with side-action bolt cutters with offset head to ensure integrity of protective galvanic layer.
   c. Remove burrs and sharp edges from cable trays.

E. Install cable management system using hardware, splice connectors, support components, and accessories furnished by manufacturer.

F. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed 90 feet.

G. Ground cable tray according to manufacturer’s written instructions.

H. The cable tray and ceiling installation shall allow for re-entry to accommodate additional cable to be pulled from all occupied spaces to their respective IDF locations on each floor. Provide the following clearance for all installation locations.

   1. A minimum of 3” clear vertical space between ceiling tile and cable tray.

   2. A minimum of 8” access headroom above the cable tray system

   3. Enough clearance on both sides of the tray to maintain accessibility with a human hand.

I. Provide bend limiters to maintain cable type bend radius whenever cable exists cable tray into TR rooms.

J. Provide radius kits at all 90-degree turns.

K. Certified Installers: Cable tray installers must have successfully completed Cablofil’s Certified Installer program.

3.3 FIRESTOPPING

A. Firestopping In Telecommunications Room at Cable Tray Entrance

1. Install EZ Path Series 44 as shown on contract drawings.

B. Firestopping where cable tray passes through a rated wall assembly.

1. Install quantity of EZ Path series 33 or series 44 to 100% fill ratio of the size of cable tray at entrance to opening.

C. General: Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.

D. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of firestopping products.

END OF SECTION 27 05 28.36

SECTION 27 08 00

COMMISSIONING FOR COMMUNICATION SYSTEMS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the equipment and execution requirements relating to Commissioning of Communications.

C. Equipment specifications, general considerations, and guidelines are provided in this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.02 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Perform all Copper Cabling Testing.
   2. Provide all Documentation, As-Builts, Training and Warranty.

PART 2 PRODUCTS

2.01 TESTING REQUIREMENTS

A. General
   1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-B.1-3. All pairs/strands of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors/strands in all cables installed.

B. Copper Testing
   1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category 6 performance. Horizontal balanced twisted pair cabling shall be tested using a level III test unit for category 6 compliance (data) and category 6 compliance (voice) and performance up to 350 MHz.
   2. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. The test shall be recorded as pass/fail as indicated by the test unit and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
   3. Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA/EIA-568-B.1-3 Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.

C. Fiber Testing
   1. All fiber testing shall be performed on all fibers in the completed end-to-end system. There shall be no splices unless clearly defined in the RFP and/or Drawings. These tests

also include continuity checking of each fiber.

2. Test set-up and performance shall be conducted in accordance with ANSI/TIA/EIA-526-7 and/or ANSI/TIA/EIA-526-14 Standards, and to the manufacturer's application guides.
3. Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.
4. Multimode - Test the optical fiber cable bi-directionally with an OTDR and uni-directionally with a power meter / light source. Fiber must be tested at both 850nm and 1300nm. Maximum attenuation dB/Km @ 850nm/1300nm shall be 3.5/1.5. Maximum attenuation per connector pair shall be .75 dB.
5. Singlemode - Test the optical fiber cable bi-directionally with an OTDR and uni-directionally with a power meter / light source. Fiber must be tested at both 1310nm and 1550nm. Maximum attenuation dB/Km @ 1310nm/1550nm shall be 0.5/0.5 for outside plant and 1.0/1.0 for inside plant. Maximum attenuation per connector pair shall be .75 dB.

D. Test Results
1. Test documentation shall be provided on disk as part of the as-built package. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair (or strand) and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
2. The field test equipment shall meet the requirements of ANSI/TIA/EIA-568-B.1-3.
3. Printouts generated for each cable by the wire test instrument shall be submitted as part of the documentation package. Alternately, the contractor may furnish this information in electronic form (CD). These diskettes or CDs shall contain the electronic equivalent of the test results as defined by the bid specification and be of a format readable from Microsoft Word.
4. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

PART 3 EXECUTION

3.01 DOCUMENTATION & AS-BUILTS

A. As-Built record documentation for telecommunications work shall include:
1. Cable routing and identification
2. System function diagrams
3. Manufacturers' description literature for equipment
4. Connection and programming schedules as appropriate
5. Equipment material list including quantities
6. Spare parts list with quantities
7. Details not on original Contract Documents
8. Test Results
9. Warranties
10. Release of Liens

B. The Contractor shall provide and maintain at the site a set of prints on which shall be accurately shown the actual installation of all work under this section, indicating any variation from contract Drawings, including changes in pathways, sizes, locations and dimensions. All changes shall be clearly and completely indicated as the work progresses.

C. Progress prints shall be available for inspection by the Owner or any of his representatives and may be used to determine the progress of Telecommunications infrastructure work.

D. At the completion of the work, prepare a new set of as-built drawings, of the work as actually noted on the marked-up prints, including the dimensioned location of all pathways.

E. Furnish as-built drawings and documentation to the Project Engineer for review and approval. As-built drawings shall be generated in AutoCad 2018 or later. Submit as-built drawings electronically on C.D. and hard copy.

3.02 OPERATIONS AND MAINTENANCE MANUAL

A. After completion of the work, the Contractor shall furnish and deliver to the Engineer three (3) copies of a complete Operations & Maintenance Manual. A system wiring diagram shall be furnished for each separate system.

B. The manual shall be subdivided into separate sections with tab dividers to identify subsystems of the integrated system. Reference appropriate specification sections.

C. Provide the following additional information for each electronic system. Information shall be edited for this project where applicable.
   1. Operations manuals for components and for systems as a whole.
   2. Maintenance manuals for components and for system as a whole.
   3. Point-to-point diagrams, cabling diagrams, construction details and cabling labeling details.
   4. List of spare parts, materials and suppliers of components. Provide name, address and telephone number for each supplier.
   5. Emergency instructions for operational and maintenance requirements.
   6. Delivery time frame for replacement of component parts from suppliers.
   7. Recommended inspection schedule and procedures for components and for system as a whole.
   8. List of spare parts, materials and suppliers of components. Provide name, address and telephone number for each supplier.
   9. Complete "Reviewed" shop drawings and product data for components and system as a whole.
   10. Troubleshooting procedures for each system and for each major system component.

3.03 TRAINING

A. The Contractor shall be responsible for training of facility personnel. Training shall take place after occupancy and before acceptance and shall include programs for on-site operations and maintenance of technology and communications systems. Training shall be for not more than ten (10) people, shall be held at the Owner's site and shall be of sufficient duration and depth to ensure that the trained personnel can operate the installed systems and can perform usual and customary maintenance actions.

3.04 WARRANTY

A. General
   1. All equipment is to be new and warranted free of faulty workmanship and damage.
   2. Replacement of defective equipment and materials and repair of faulty workmanship within 24 hours of notification, except emergency conditions (system failures), which must be placed back in service within eight (8) hours of notification, all at no cost to the owner.
   3. The minimum warranty provisions specified shall not diminish the terms of individual equipment manufacturer's warranties.

B. Horizontal Structured Cabling
   1. Low voltage contractor shall provide a 25-year manufacturer warranty for components used in the installed Structured Cabling System. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.

C. Pathway & Support Infrastructure

1. Manufacturer(s) shall provide a 2-year warranty for components used in the installed Pathway & Support Infrastructure. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.

END OF SECTION

SECTION 27 41 13 - MULTIMEDIA SYSTEMS FLOORBOX

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Multimedia Systems Floorboxes

1.2 PERFORMANCE REQUIREMENTS

A. General: Floor boxes provide interface between power, audiovisual, and telecommunications cabling in concrete floors and decks at workstations or at activation locations requiring power, audiovisual, or communication device outlets.

1. ADA Compliance: Flush-mounted floor device outlets shall not create tripping hazards.

B. Floor Mounted Connector Assembly: Watertight, rubber cable pass thru gasketed door and cover assembly, utilizing basket and connector mounting panel inserts. Customize cover/door opening so that cable pass-thru will accommodate the bundle of AV cabling specified, while maintaining the ability to fully close with cables connected.

C. Labeling: Floor boxes shall bear the “cULus mark” issued by UL for units complying with both US and Canadian Standards.

D. Standards: Comply with the following:

1. UL 514A

2. National Electrical Code

1.3 SUBMITTALS

A. Related Sections

1. Comply with requirements of Section 01 33 00, “Submittal Procedures.”

B. Submittal Data

1. Submittal data is to be submitted as a complete, single digital file. All documents shall be clearly legible. Each submittal shall contain the below in the following order:
   a. Cover Sheet
      1) Include name of supplying contractor and project name.
      2) Include submittal and revision number.
   b. Detailed Bill of Materials
      1) Include a listing of: component quantities, equipment manufacturers, model numbers, descriptions of each component being supplied, and the specification paragraphs or drawing sheets that correspond to each product.
      2) The bill of materials shall be index referenced within the PDF file so that each product name is clickable, linked to the first page of the corresponding product data.

3) Failure to provide this information will result in the rejection of submittals.

c. Product Data
   1) Include a catalog sheet per product of equipment listed in the Detailed Bill of Materials, in the exact order as the Detailed Bill of Materials. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include an image of the product.
   2) Photocopy duplications of the manufacturer's original equipment catalog sheets will be allowed as long as they provide adequate clarity of both the printed word and graphics/pictures.
   3) If more than one product is shown on the catalog sheet the intended product must be denoted by either an arrow or highlight. All optional components and selections shall be clearly indicated.
   4) Indicate floor box models, trim, finish, and accessories.

2. Informational Submittals
   a. Submit Manufacturer's installation instructions.

3. Partial submittals, or submittals comprised of multiple PDF files, will not be accepted.

C. Photographs

1. Submit photographs of each placed floorbox with associated conduit prior to slab pour.

D. Shop Drawings

1. Prior to fabrication submit contractor-generated drawings for approval for all supplied systems. These drawings shall include, but are not limited to, the following:
   a. Title Sheet with sheet index and symbols legend
   b. All panels, plates, and designation strips, including connectivity, layout, labeling, and details relating to terminology, engraving, finish and color
   c. All unusual equipment modifications
   d. Equipment location drawings, dimensioned to column lines
   e. Include detailed elevation drawings, showing conduit runs and associated box knockout locations
   f. Furniture coordination drawings, depicting planned cable pathway to furniture raceway or outlets, where applicable

2. Drawings should be at project standard scale and clearly legible.

3. Resubmission of contract drawings does not constitute a complete shop drawings submittal and is unacceptable. Such submittals will be rejected.

E. Form

1. Submit all materials for review as described above, specifically referenced to the specification paragraph number (where applicable).
   a. Submit all drawings on sheets of one size, preferably the project standard size.
   b. On submittal drawings, maintain 3/32" minimum lettering height. Submittals with text less than 1/16" in height may be rejected.

2. Partial Submittals may be rejected. If submitted individually and each in its entirety, the following submittals shall not be considered partial:
   a. Personnel
   b. Milestones

c. Conduit Verification Statement and Notifications
d. Rigging and Mounting Drawings
e. As-Built Documentation

3. Product Data and shop drawings must be submitted together in order to be reviewed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the specified requirements, provide products by one of the following available manufacturers. Manufacturers offering products that may be incorporated into the work include, and are limited to, the following:

1. Legrand/Wiremold
2. Approved equal

B. Multimedia Systems Floorbox:

1. In-slab: EFB8S-OG

2. Raised floor: EFB8S

3. Fire classified: EFB8S-FC

2.2 MATERIALS

A. Door and Cover: Not lighter than 11-gauge steel with integral, self-trimming carpet trim ring. Mount trim ring flush with floor covering. Secure with security socket head screws.

1. Finish: Satin black coating

2. Trim: Door, cover, and integral trim ring shall have radiused corners.

B. Device Plates

1. Provide device plates as detailed on drawings.

2. Provide blank plates for all unused openings.

C. In-slab Boxes

1. 11-gauge steel, 15 13/16 inches by 12 3/4 inches by 6 1/16 inches deep

2. Mount on manufacturer’s backbox.

D. Raised floor Boxes

1. 11-gauge steel, 15 13/16 inches by 12 3/4 inches by 6 1/16 inches deep

2. Provide toggle clamps to allow box to be secured to raised floors.

E. Fire classified floor Boxes

1. 11-gauge steel, 15 13/16 inches by 12 3/4 inches by 6 1/16 inches deep

2. Provide fire-rated backbox and install per manufacturer's instructions.

3. All boxes shall maintain a minimum of 1 hour of fire rating.

F. Provide pull strings in each conduit at floor box location. Coordinate conduit to box knockout location with telecommunication cabling and audiovisual systems requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The minimum concrete pour depth shall be 7 inches less decking. For pour depths less than 7 inches, provide structural bracing and firestopping as necessary.

B. With Installer present, verify that manufacturer's requirements for floor opening and infrastructure conditions have been satisfactorily met. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Arrange for jobsite approval of the equipment prior to installation.

B. Verify exact locations of floorbox installation.

C. Coordinate all box locations with furniture onsite prior to installation.

3.3 INSTALLATION

A. Install equipment in compliance with approved shop drawings and manufacturer's installation instructions.

B. Install in position and relationship to adjoining work indicated, securely anchored to supporting structure, sealed and finished, and in a manner which produces a level box with square, plumb, and straight edges.

C. Coordinate installation with floor covering to finish each floor box. Install floor covering with oversized cable management pop-up pass-thru in top, matching surrounding floor covering in cover insert.

3.4 ADJUSTING

A. Adjust door/cover for proper operation.

3.5 PROTECTION

A. Protect installed equipment in original undamaged condition until Substantial Completion. Replace damaged components for units that cannot be repaired prior to Substantial Completion.

END OF SECTION 27 41 13

SECTION 27 60 00

EMERGENCY RESPONDER RADIO COMMUNICATION SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Provide a complete Emergency Responder Radio Repeater System (ERRCS) for the entire building(s) and/or structure(s) included in this project. The system(s) shall comply with the latest specifications and standards of NFPA 72, and shall meet all requirements of International Building Code IBC Section 915, and the International Fire Code IFC Section 510.

B. The ERRCS shall be approved by the city, county or local AHJ and shall amplify the agency's two-way radio signals to provide adequate radio coverage throughout the building or structure for first responders.

C. The system design, components and performance shall meet all operational requirements of the Fire Department and other agencies in the jurisdiction in which system shall be installed.

D. Section Includes:

1. System design.
2. Rooftop donor antenna(s).
3. Bi-directional amplifiers (BDA's).
4. Battery backup system.
5. Equipment racks and supports.
6. Remote annunciators.
7. Indoor distributed omni-directional antennas.
8. Coaxial and fiber optic cables.
9. Splitters.
10. Grounding.
11. Terminations, connections, clamps and all misc. hardware.
12. Testing and commissioning.
13. Adjustments.

E. The full ERRCS systems shall be provided as part of the Base Bid. However, the bids shall include breakout pricing for the following categories of work. The Phase 1 scope shall include:

1. Initial RF Signal Strength calculations based on project location and building design drawings.
2. Conduit pathways for Vertical Riser Cables in conduit from rooftop to lowest floor.

F. The following Phase 2 scope for installation of the ERRCS systems shall be provided as part of a separate break-out cost, as follows. If the building does not require an ERRCS,

then this portion shall not be invoiced

1. Post-construction site survey and RF signal-strength mapping of all areas within the building.
2. Permits as required.
3. NEMA 4 enclosures on each floor, with cable taps and fittings, as required.
4. Taps and horizontal cabling concealed in ceiling cavities of corridors, installed end to end in all buildings.
5. Taps in horizontal cabling at regular intervals, to permit future connection of omni-directional antennae in corridors.
6. Conduit/raceway from indicated location of BDA amplifier cabinet on top floor to roof for future Donor Antenna.
7. Rooftop Donor Antenna.
8. Bi-directional amplifier, cabinet and battery backup unit.
9. Omni-directional antennae throughout building as required.
10. Fire alarm monitoring of ERRCS system.
11. All required enclosures, conduit, raceways for complete system.
12. All required cable terminations, connections, etc. required for complete system.
13. Remote status panel at the building entrance or fire command center.
14. All system adjustments, programming, fine tuning and testing for an approved system by the local AHJ.
15. Walk-thru testing with the local AHJ, fire department, etc.
16. All other materials, labor, etc as specified in this section, and not provided under the Phase 1 scope and cost.

G. Related Sections:

1. Section “Common Work Results For Electrical.”
2. Section “Grounding & Bonding For Electrical Systems” for grounding, bonding and interconnection of equipment to building and service grounds.
3. Section “Raceways & Boxes for Electrical Systems” for conduit, raceway and box requirements.
4. Section “Low Voltage Electrical Power Conductors and Cables” for cabling requirements.

H. Permits and Fees:

1. Apply for, make payment, secure and obtain all necessary and required permits relative to work of this section.
2. System designer/installer shall submit all system information, design, etc. to the Fire Department and local Building Permit/Inspection Department for review and approval.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. System design shall be by certified technician or registered Professional Engineer specifically trained and qualified in the design of Emergency Responder Radio Communication Systems, distributed antennae systems and emergency communications.
2. Designer shall estimate ERRCS signal levels at the donor location and provide a detailed system design that will meet the coverage and capacity requirements of the AHJ. System shall be designed to provide better than -90 dBm coverage to

greater than 95% of the structure, as required by applicable Codes.

3. The system shall consist of directional amplifiers with a discrete distributed antenna system.
4. Address all areas that typically have poor communications, including:
   a. Stairwells
   b. Elevators and machine rooms
   c. Areas surrounded by metal and/or concrete.
5. ERRCS shall support all local First Responder's radio network frequencies. It shall operate at the elevators, elevator lobbies, emergency and standby power rooms, standpipe hose connection locations, the, mechanical and electrical rooms, elevator equipment rooms, entries into required exit stairways, rooms containing the main electrical service disconnecting means, stair enclosures, shall also be transparent to communication signals.
6. Amplifiers shall be powered by a dedicated uninterruptible power source (UPS) with a minimum backup time of twelve (12) hours with all amplifiers at rated output. The UPS input circuit shall be a dedicated circuit and connected to the emergency/standby generator.
7. All components, cables, and system shall be sized and selected for complete and functional system.
8. Design shall appear as a part of the building or structure, with conductors concealed within columns, walls and above ceilings, where possible and practicable.
9. System components shall be located or rated for required system survivability, including routing of riser cables within 2-hour rated enclosures/chases/rooms or use of 2-hour rated cables.
10. Select locations for equipment, which shall minimize need to disturb for future building maintenance and repair of roofing. Cable runs on roof surface shall be minimized, where practicable.

B. Performance Requirements: This is a performance specification. It is the full responsibility of the designer/installer to insure that the design and installation conforms to all applicable standards and Codes, and is acceptable to the AHJ.

C. Antenna Isolation: Provide antenna isolation of 15 db higher than the gain of the amplifier per NFPA. If required for proper isolation, provide directional antenna(s) in addition, or in place of omnidirectional antenna(s) to provide for proper coverage and signal strength and antenna isolation.

D. Local System Compatibility: System installation, components and performance shall be fully compatible with:
   1. Baltimore County, to ensure their macro radio network is not disrupted.
   2. System shall operate on both 700MHz and 800MHz.

1.4 SUBMITTALS

A. General: Submit each item in this Section according to the conditions of the contract and Division 01 Specification Sections.

B. Submittals shall also comply with the submittal procedures and requirements of electrical

Specification Sections.

A. Submittal Requirements of this section:

1. Roof plan showing donor antenna location(s).
2. Indoor plans for each level showing antennae, risers, splitters, amps, etc.
3. Antennas and mounting and anchoring components.
4. Amplifiers.
5. Equipment racks, enclosures, etc.
6. Cables and associated terminations and connectors.
7. Ground and bonding connections.
8. Indoor active amplifiers and/or repeater devices.
9. Indoor omni-directional antennas.
10. Battery Backup Units.
11. All other miscellaneous hardware.

B. Descriptive Data:

1. Manufacturer's specifications, data sheets.
2. Catalog cuts.
3. Dimensional drawings.
4. Installation Instructions.
5. Clearly indicate the exact size or rating proposed.
6. To verify specifications have been met/exceeded.
7. UL Listing of each component individually.
8. Clearly indicate or state options, etc.:
    a. Manufacturer/cat. number.
    b. Construction data, materials, as applicable.
    c. Label each conductor or cable type, and its proposed application or location.
    d. Identify each component with a cross reference to the drawings.
    e. Drawings and installation instructions.
    f. Details to demonstrate that the system has been coordinated and will function as one unit.

C. System Design Drawings:

1. Identify each component used in the system.
2. Indicate all building penetrations, and method proposed at each location.
3. Indicate attaching methods for all components.
4. Indicate proposed layout, including relationship to other parts of work.
5. Drawings shall be stamped and signed by a licensed professional engineer experienced in the design of RF systems.

D. Floor Plans & Elevations:

1. Scaled Floor Plans of each building level shall be furnished, to indicate:
    a. Scaled floor plans of all building areas and floor plans.
    b. Location and type of all proposed devices.
    c. Minimum of (1) building elevation depicting the location of any/all outdoor antennas. Include height of antenna centerline above building, orientation, and location of all external grounding connections.
    d. Detail elevation view(s) of all rack(s) and/or enclosure(s) housing the Emergency Responder Radio Communication System equipment.

Identify each piece of equipment by brand, model number and equipment type (e.g. RF amplifier).

E. Wiring Diagrams:

1. Wiring connection diagrams for each proposed component.
2. Schematic wiring diagram for entire system, showing all connected devices, cable types, cable sizes, etc.
3. Differentiate clearly between factory and field-installed wiring.
4. Indicate all points of connection between proposed system and other systems, such as AC power connections.

F. Approval of Authority Having Jurisdiction:

1. Submit copies of Shop Drawings to Authority having Jurisdiction. Submit for review and approval, as required for permit.
   a. Proposed system and all components.
2. Comply with all comments. Make necessary corrections.
3. Provide copy of all written comments and direction to Owner and Architect.

G. Closeout Submittals: Submit in accordance with the General Conditions and Division 01 requirements, and Section “Common Work Results for Electrical”, and as follows:

1. Operational Information: Provide full instruction manual to cover all aspects and components of the installed system and to be used to supplement the Owner Demonstration:
   a. System equipment locations.
   b. Component reset.
   c. Power on/off procedures.
2. Installed Product Data: Product data sheets for all electronic equipment, fiber and coaxial cable, splitters, couplers and antennas
3. Maintenance Data: Provide for all equipment and accessories to include in the "Operating and Maintenance Manual" specified in Division 01.
   a. Include recommended periodic tests of equipment in service, and test parameters. Provide manufacturer’s recommended test procedures, frequency and type of tests.
   b. Specify cleaning procedures for all components.
4. As-Built Drawings: Provide three (3) full-size copies of all plans, drawings and schematics to the owner after the acceptance test. The drawings shall show all terminal designations, location of all junction boxes, terminal cabinets, devices, wiring and conduit routings. Drawings, etc. shall be delivered as part of the O&M Manual package.
5. As-built system design documentation including design assumptions, power budgets, system block diagram, and floor plans showing cable routing, antenna locations, and equipment locations.
6. Post Installation signal strength test results, indicating acceptable transmit/receive signals in all building areas.
   a. Results of test showing RSSI and MOS scores measured at discrete points within a 50’ or less grid pattern verifying >95% coverage at -90 dBm or greater.
   b. RSSI levels at each interior antenna.
   c. BDA commissioning documentation including date of commission, actual off-air downlink levels at the donor antenna and BDA, isolation between the donor antenna(s) and the DAS, and BDA gain and AGC settings.

1.5 ELECTRONIC AUTOCADD DOCUMENTS

A. Requests for electronic Autocadd documents will be accommodated to the contractors and installers upon receipt of Bowman's Electronic Document Release Form. Refer to Section "Common Work Results for Electrical" for additional information.

1.6 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100 (NEC).
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
3. Where equipment consists of multiple components, the entire assembly or product shall be UL Listed and Labeled, or Labeled by a testing organization acceptable to the Authority Having Jurisdiction per the NEC.

B. Manufacturer's Requirements:

1. Engaged in manufacturing of distributed antenna systems and equipment for emergency responders at least 5 years.
2. Provide local maintenance and service with location less than 100 miles from project site.
3. Provide technical support to installer.
4. Maintain, within 50 miles from site, a maintenance and service organization complete with parts inventory and repair facility.

C. Single-Source Responsibility:

1. Obtain radio system components from a single source who assumes responsibility for compatibility of all system components
2. The complete installation and performance of the installed system, including all accessories shall be the sole responsibility of the Radio Repeater system installer. It is the installer's responsibility to ensure that all field installed accessories and loose components used in the system, meet these specifications, and perform up to the stated and tested standards.
3. Coordinate the components of the system and their arrangements electrically and mechanically.

D. Installer Qualifications:

1. System planning, design and installation shall be performed by a Certified ERRCS designer.
2. Has installed a minimum of fifteen (15) similar radio repeater systems of similar size and conditions within the local area.
3. Has installed a minimum of three (3) similar radio repeater systems within the same jurisdiction and for the same fire department, AHJ, etc. as this project,
4. Factory-authorized installer to perform work of this Section.
5. Provide references upon request:
   a. Names of six (6) similar projects in size and scope.
   b. Contact person and phone number for each project.

E. Installation Quality: In accordance with the following Codes and Standards.

1. Federal Communications Commission (FCC)
   a. FCC 47 CFR Private Land Mobile Radio
   b. FCC Rules Part 22, Part 90 and Part 101
   c. FCC's OET 65 Standards "Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields"
2. NETA National Electrical Testing Association
3. NFPA National Fire Protection Association
   a. NFPA 1 National Fire Code
   b. NFPA 70 National Electrical Code
   c. NFPA 72 National Fire Alarm Code
   d. NFPA 101 Life Safety Code
   e. NFPA 1221 Installation, Maintenance and Use of Emergency Services Communications Systems
4. UL Underwriters Laboratories

F. Certification of all system components:

1. Catalogued by the system manufacturer.
2. UL Listing of each component individually.

1.7 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection:

1. Store all materials under cover, in trailers, buildings, etc.
2. Protect all materials from physical damage and exposure to weather, prior to installation.

1.8 PROJECT CONDITIONS

A. The radio repeater system and components shall be installed on and in the structure during or following the overall project construction. Walls, ceilings and other finishes may be in progress or complete at the time of the radio repeater system installation. All work shall be coordinated to accommodate such conditions and avoid damages to such prior or existing construction.

1.9 SEQUENCING

A. General Sequencing:

1. Coordinate radio repeater system installation with roof, steel, exterior and/or interior construction.
2. Provide for roof penetrations, attachments to roof or structural components.
3. Provide for grounding connections to steel.
4. Provide concealed conduit and cable installations, where applicable, prior to wall close-in or ceiling installations.
5. Coordinate core drilling or similar penetrations early in construction to avoid damage to installation of final finishes and materials, and to limit debris/dust.

1.10 COORDINATION

A. Installer shall examine the structure, walls, finishes and all items of construction affecting his work.

B. Coordinate installation with all other trades.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, provide a system by one of the following named manufacturers/installers, or approved equal:

1. Notifier/Honeywell
2. Stat Communications.
3. Morcom International, Inc.
4. Atek Communications.
5. Axell Wireless.
6. CommScope/Andrew
7. Corning
8. Times Microwave
9. Tessco
10. CCI (Communication Components Inc.)
11. Solid Technologies

2.2 MATERIALS

A. All equipment and materials shall be new.

B. All system components shall be UL Listed or ETL tested/labeled.

C. Provide fire rated coaxial cable with connectors from the roof level down to system head end equipment.

D. Provide plenum rated ½ inch coaxial cable with connectors for all horizontal runs.

E. Provide plenum rated fiber optic cable and connectors meeting manufacturer’s recommendations for all fiber runs.

F. All materials installed in the plenum including passive devices, hangers, and ties shall be plenum rated.

G. All passive system components including but not limited to splitters, taps, directional couplers and indoor antennas shall support 700 MHz to 2500 MHz.

2.3 POWER SUPPLIES

A. At least two (2) independent and reliable power supplies shall be provided, one primary and one secondary.

B. Primary power source shall be supplied from a dedicated 20 ampere branch circuit and comply with 4.4.1.4 of NFPA 72.

C. Secondary power source shall be a dedicated battery unit, capable of operating the in-building radio system for at least 12 hours of 100% system operation. The battery system shall automatically charge in the presence of external power input. The battery system shall be contained in one NEMA 4 or 4X type enclosures. Monitoring the integrity of power supplies shall be in accordance with 4.4.7.3 of NFPA 72.

2.4 SURVIVABILITY

A. Physical Protection: All wiring and fiber optics shall be installed in conduit.

B. Fire Performance: All main riser or trunk cables of the antenna system shall be installed with resistance fire using one of the following methods:

1. A 2-hour fire rated cable or cable system.
2. Routing the cable through a 2-hour fire rated enclosure(s) or shaft(s).
3. A system configured in a looped design, routed through 1-hour fire rated enclosure(s) or shaft(s).
4. The circuit shall be capable of transmitting and receiving a signal during a single open or non-simultaneous single ground fault on a circuit conductor.
5. Performance alternative approved by the authority having jurisdiction.

C. Cabinets: The signal booster and all associated RF filters shall be housed in a single, NEMA 4 certified, painted steel weather tight box. The cabinet shall be large enough to dissipate internal heat without venting the inside of the cabinet to the outside atmosphere. Operating temperatures: –22 degrees F to +120 degrees F minimum temperature range, including microprocessors.

D. Equipment installed on the roof of structures shall be rated for the expected extreme temperatures associated with rooftop installations.

E. Passive Equipment: Passband shall be 700-900 MHz, IP rating of 2 GHz.

F. Cable: Passband shall be 700-900 MHz. Cable shall be rated for fire plenum and riser rating.

2.5 SYSTEM COMPONENTS

A. Signal Strength:

1. Downlink: A minimum signal strength of -95 dBm shall be provided throughout the coverage area.
2. Uplink: Minimum signal strength of -95 dBm received at the local Fire Department Radio System from the coverage area.
3. A donor antenna must maintain isolation from the distributed antenna system. The donor antenna signal level shall be a minimum of 15 dB above the distributed antenna system under all operating conditions.

B. Permissible Systems:

1. Buildings and structures shall be equipped with an FCC Certificated Class B Bi-Directional UHF Amplifier(s) as needed.
2. The distributed antenna system may utilize a radiating cable, fixed antennas or a combination of both.

C. Supported Frequencies: The radio system shall support frequencies in the 700 and 800 MHz public safety bands as utilized by the local Fire Department.

D. Reject Filters: Notch filter sections shall be incorporated to minimize adjacent channel cellular and SMR (Nextel) degradation of the signal booster performance. The minimum downlink band adjacent band rejection shall be 35 dB or greater at 865 MHz and 870 MHz.

E. Band Migration Capability: The signal booster shall include re-tunable or replaceable filters to accommodate rapid and economic passband changes in the event of mandatory FCC changes within the NPSPAC band. The use of non-adjustable and non-replaceable RF input and output filters is prohibited.

F. Output Level Control: An automatic output leveling circuit shall be included for both passbands with a minimum dynamic range of 60 dB, less any gain reduction setting, to maintain FCC out of band and spurious emission compliance.

G. Degraded Performance in Emergencies: The system shall be designed to allow degraded performance in adverse conditions, such as abnormally high temperatures resulting from nearby fires, extreme voltage fluctuations or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e. under/over voltage, over/under current, over/under temperature, etc.) will not be implemented as the standard mode for public safety applications.

H. Mode of Operation: The system shall be normally powered on and shall continuously provide passing of frequencies within the Public Safety and First Responder bands.

I. All in-building radio systems shall be compatible with both analog and digital communications simultaneously at the time of installation.

2.6 SYSTEM MONITORING

A. The ERRC system shall include a connection to the fire alarm system to monitor the integrity of the circuits of the signal booster(s) and power supplies and annunciate this malfunction on the fire alarm system shall comply with 4.4.7.1 of NFPA 72.

B. A sign shall be located at the fire alarm panel with the name and telephone number of the local Fire Department indicating that they shall be notified of any failures that extend past the 2 hour time limit.

2.7 EQUIPMENT BACKBOARDS

A. Equipment backboards for use in mounting all radio repeater system equipment, racks, etc.

1. 3/4" BC grade fire retardant treated plywood.
2. Shall contain no urea-formaldehyde.
3. Shall bear a “UL Classified” marking from the manufacturer.
4. Minimum size of 48"W x 84"H, or as noted.
5. Hoover *Pyro-Guard* treated wood, or equal.
6. Paint with white, intumescent fire retardant paint.
    a. Class A fire rated.
    b. Low VOC, interior flat latex, fire retardant paint.
    c. Intumescent when exposed to flame.

d. Flame Control Coatings, LLC. Intumescent Fire Retardant Paint, or equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions: Examine the conditions under which the equipment shall be delivered, installed, and operated. Make all allowances required for installation and maintenance of the equipment, per Codes and manufacturer.

3.2 SITE SURVEY

A. Before designing the radio repeater system for the new or existing building, a comprehensive site survey shall be conducted to obtain all information needed to ensure a successful system design. During the site survey:
1. Test existing signal levels
2. Test for signal interference
3. Identify areas that need to be reinforced (as well as any that do not)
4. Review building pathways for constructability planning
5. Review potential donor antenna locations
6. Review possible equipment locations for headend equipment, fiber infrastructure and power.

3.3 INSTALLATION

A. General Requirements:

1. The system shall be provided in accordance with the applicable International Fire Code and its amendments.
2. Provide necessary donor antenna(s) on the roof level.
3. Fire stopping shall be installed at any new or existing fire rated wall and ceiling penetrations.
4. All equipment and materials shall be installed according to manufacturers' recommendations.
5. Install all equipment, as indicated and per manufacturer's written instructions.
6. Do not install equipment where location impedes access to other equipment or creates unsafe conditions. Install in suitable, alternate location.
7. Coordinate the installation of the radio repeater system with the work of other trades and contractors prior to laying out system or beginning work.

B. Roof Antenna:

1. Install roof yagi antenna using permanent, fixed mounting to roof structural components such as elevator or stair tower extensions above roof, or permanently mounted pipe support.
2. Ballasted antenna trays and racks are not acceptable.
3. All hardware shall be galvanized steel or stainless steel.
4. Install such that no components present a tripping or other risk to workers on roof.

C. Roof Antenna Cables:

1. Avoid creation of U or V pockets on roof surfaces that can trap water or debris.
2. Prevent sharp bends or turns.

3. Concealed conductors shall be fastened as required to maintain position and hold permanently in place.

D. Grounding of Roof Antenna:

1. Ground all metal roof antenna bodies, per manufacturer, and NEC to protect against lightning strike.
2. Bond to rooftop lightning protection system, where building is so equipped.

E. Roof Penetrations:

1. Where the system requires penetration of the roof, make such penetration utilizing manufacturer's recommended products, approved by the roofing system installer.

F. Bi-Directional Amplifier(s):

1. Locate, with preference being in IT rooms/closets. Avoid locations in electrical rooms/closets.
2. Install per manufacturer's written instructions.
3. Surface mount, using equipment rack or mounting hardware.
4. Provide ceiling smoke detector in room with BDA.

G. Cabling:

1. Comply with all manufacturer's written installation instructions.
2. Install vertical cable through core drilled holes in slabs. Follow pathways through stacked IT closets, where practicable.
3. Fire stop all penetrations through rated floors, walls or ceilings.
4. Wires or cables routed between consoles, cabinets, racks, and other equipment shall be installed in an approved conduit or cable tray that is secured to building structure.
5. Support horizontal cable runs on J-hooks, or similar approved support method. Do not rest cables on ducts, ceilings, etc.
6. Route cables to provide sufficient separation from sources of interference, including: power cables, IT cables, VFD's, control panels, etc.
7. Cables shall not be kinked, or bent beyond limits stated by manufacturers.
8. Provide "S" loops where cables connect to field antennas, to allow for movement, and/or filed adjustment to antenna location.
9. Wires and cables shall enter each equipment enclosure, console, cabinet or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of the cables.
10. Completely test all of the cables after installation and replace any that are found to be defective.

H. Omni-directional Antennas:

1. Locate in ceilings, where determined by design.
2. Support independently from ceiling grid or tiles.
3. Install per manufacturer's written instructions.

I. Splitters and Taps:

1. Locate in IT closets, or other space below ceilings, where determined by design.

2. Mount on fire rated plywood backboards.
3. Provide grounding, as applicable, to building steel.
4. Install per manufacturer’s written instructions.

J. Field Wiring:

1. Comply with National Electrical Code.
2. Install all AC power cabling in conduit or metal raceway according to Section "Raceways & Boxes for Electrical Systems." Conceal raceways except in unfinished spaces and as indicated.
3. Do not mix radio repeater system cabling in same raceways/boxes with wiring of any other system.

K. Grounding:

1. Refer to Section “Grounding & Bonding for Electrical Systems” for general requirements, in addition to those specified herein.
2. Ground cable shields and equipment according to system manufacturer's instructions to eliminate shock hazard and to minimize, to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments.
3. Ground equipment and conductor and cable shields.

L. Electrical Power:

1. Connect all radio repeater system components, requiring power to the building’s 120VAC power system, as indicated. Connect to Emergency Power system (life safety), where so equipped.
2. Provide dedicated circuit for each system amplifier, remote unit, distributed amp, etc.
3. Clearly label "EMERG RESP COMM SYSTEM" on panelboard directory.
4. Locking clip for breaker handle to lock in "ON" position, but not prevent tripping of breaker.

M. Identification: Identify system components, wiring, cabling, and terminals according to Section “Common Work Results for Electrical”.

3.4 REPAIR/RESTORATION

A. Restore all finishes, equipment, surfaces and/or grade to original condition, where affected by the work of this section.

B. Comply with all requirements as specified in Section “Common Work Results for Electrical”.

3.5 FIELD QUALITY CONTROL

A. Installation shall meet all the requirements of UL Master Label for such systems.

B. Installer's Field Services:

1. Provide services of a factory-authorized service representative to make all connections of all system cabling at amplifiers, antennae, converters, splitters, and associated components and accessories.

2. Be present and supervise all pretesting of cabling system prior to connections to control equipment.
3. Be present and supervise the adjustment of all settings, components and accessories.
4. Provide all system adjustments, fine tuning, etc., based on project conditions.
5. Assist in the troubleshooting, as necessary to provide a system free from all faults, trouble conditions, etc. prior to required testing by AHJ.

C. Pretesting:

1. After installation adjust, and balance the system and perform complete pretesting.
2. Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications, and local AHJ requirements.
3. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved.
4. Prepare forms to document the systematic recording of acceptance test results.

D. Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of the witnesses to the preliminary tests.

E. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.

F. Provide all testing to certify the system is complete and fully operable.

1. All tests required by Authority Having Jurisdiction.
2. Provide written statement of successful test results.
3. Submit letter to Owner and Architect.
4. Perform tests in presence of Owner or Authorized Representative.
5. Manufacturer's technician shall be present to make adjustments related to the testing.

G. Site Tests:

1. Schedule tests and provide notification at least one week in advance of any test commencement.
2. Post-Installation Testing: After completing system installation, perform the following tests, in addition to any/all testing per NFPA.
    a. Connect carrier and public safety systems to the headend;
    b. Optimize power levels per design and carrier specifications;
    c. Test live system performance and provide coverage map;
    d. Absences of grounded, shorted or open circuits.
    e. All antennae, amplifiers, and other active components, function as required.
    f. UPS System batteries can operate the system for minimum time duration required.
    g. Test all copper conductors for short circuits or grounds, using an insulation-testing device.
    h. Make ground resistance tests for system, per Section “Grounding & Bonding For Electrical Systems.”
    i. Inspect accessible components for cleanliness, mechanical, and

electrical integrity, for presence of damage or deterioration. Correct all deficiencies are corrected.

j. Inspect all electrical connections for tightness.

k. Using a spectrum analyzer, test all building spaces to prove adequate signal strength in all areas, across all applicable frequencies, and in both transmit and receive modes.

l. Record and document all test results.

H. Submit a completed installers' checklist and forms indicating all components have been tested and found operational and satisfactory.

I. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

J. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log upon the satisfactory completion of tests.

K. Inspections by AHJ:

1. Arrange all required inspections by the local Fire Department, Fire Marshal, and/or Authority Having Jurisdiction.
2. Notify all parties, including owner and architect, at least 2 weeks in advance of scheduled Inspections.
3. Document and distribute results of testing to all parties.
4. Perform all adjustments, changes, etc. required.
5. Provide for re-inspections, if required.

3.6 APPROVAL TESTING

A. The local Fire Department will review plans and specifications. Upon acceptance, plans will be stamped to indicate approval. Stamped plans are required to be present at the acceptance test. Any field changes that occur during construction shall be incorporated into new As-Built plans, including any manufacturer's data sheets for any equipment changes not submitted in the original submittal. As-Built plans, if required due to system changes, shall be submitted to the local Fire Department for approval.

B. Tests shall be made using frequencies close to the frequencies used by the Fire Department and appropriate emergency services. If testing is done on the actual frequencies, then this testing must be coordinated with the local Fire Department unit. All testing must be done on frequencies authorized by the FCC. A valid FCC license will be required if testing is done on frequencies different from the police, fire or emergency medical frequencies.

C. Testing Procedures:

1. Minimum Signal Strength: For testing system signal strength and quality, the testing shall be based on the delivered audio quality (DAQ) system. A DAQ level below 3.0 shall be considered a failed test for a given grid cell.
2. Measurements shall be made with the antenna held in a vertical position at 3 to 4 feet above the floor to simulate a typical portable radio worn on the belt or turnout coat pocket.

D. Final Acceptance Testing

1. All acceptance testing shall be done in the presence of a local Fire Department representative or by the local Fire Department unit at no expense to the City.
2. Small scale drawings (11 inch x 17 inch maximum) of the structure shall be provided by the Contractor to the Owner. The plans shall show each floor divided into the grids as described above, and the results of the pre-testing. Each grid shall be labeled to indicate the DAQ result from the final acceptance testing.
3. The Contractor shall provide the latest approved plans for the system, including any manufacture's data sheets for any equipment changes not submitted in the original submittal to the Owner.
4. Include testing results of the repeater (output wattage, gain level, etc) and connection to the fire alarm.

3.7 ADJUSTING

A. Sensitivity Adjustments:

1. Initial Settings: Provide initial setting of all antennae, amplifiers, etc. prior to final testing, based on original calculated distances, cables, construction, etc.
2. Final adjustments: Provide all required adjustments after installation to provide peak performance.
3. Provide additional adjustments, as required, from AHJ inspections and testing.

3.8 CLEANING

A. General:

1. Remove paint splatters and other spots, dirt, and debris.
2. Touch up scratches and marred finishes to match original finish.
3. Clean front panels of all control panels, amplifiers, etc. using methods and materials recommended by manufacturer.

3.9 LICENSING

A. All fees associated with the licensing shall be paid by the Owner.

B. All testing must be done on frequencies authorized by the FCC.

3.10 DEMONSTRATION

A. System Installer shall provide a factory trained representative for purpose of training owner's personnel:

1. Discuss proper operation, maintenance, and use of system.
2. Instructor shall be fully knowledgeable of the installed system and all components.
3. Training shall be completed at the project site following Owner occupancy, at Owner’s discretion.
4. Schedule after all final tests, adjustments and Owner's acceptance.
5. Training shall include use of delivered O&M manuals.

3.11 MAINTENANCE AND ANNUAL TESTING

A. Annual tests will be conducted by the local Fire Department unit or authorized company.

1. The re-testing will be done at no expense to the City or the appropriate emergency services departments as required in the original testing procedures.

B. Maintenance Contract

1. Maintenance contract with a Radio Service Provider in place with name of authorized company, who will provide a 24 hour by 7 day emergency response within two (2) hours after notification. The system shall be maintained in accordance with FCC requirements. The contract shall be for 5 years.
2. All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radio telephone Operator License, or a technician certification issued by the Association of Public-Safety Communications Officials International (APCO) or equivalent as determined by the local Fire Department.
3. Maintain a list of contact personnel with phone numbers at the radio repeater system cabinet. The contact personnel shall have knowledge of the building and the repeater system and be available to respond to the building in the case of an emergency.
4. Radio Service Provider maintenance contract shall include but not limited to:

    a. Annual Test
        1) All active components of the distributed antenna system, including but not limited to amplifier, power supplies, and back-up batteries, shall be tested a minimum of once every 12 months.
        2) Amplifiers shall be tested to insure that the gain is the same as it was upon initial installation and acceptance. The original gain shall be noted and any change in gain shall be documented.
        3) Back-up batteries and power supplies shall be tested under load for a period of 1 hour to verify that they will operate during an actual power outage.
        4) Active components shall be checked to determine that they are operating within the manufacturer's specifications for their intended purpose.
        5) Documentation of the test shall be maintained on site and a copy forwarded to the local Fire Department Radio Supervisor upon completion of the test.

5. Fire Department Radio personnel, after providing reasonable notice to the Owner or their representative, shall have the right to enter onto the property to conduct field testing to be certain that the required level of radio coverage is present

END OF SECTION

SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Device guards.
7. Remote annunciator.
8. Addressable interface device.
9. Digital alarm communicator transmitter.
10. Network communications.
11. System printer.

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.

    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Locate detectors according to manufacturer's written recommendations.
12. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician; Level III minimum.
    c. Licensed or certified by authorities having jurisdiction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Data: Certificates, for fire-alarm control unit, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in other section for "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:

a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Record copy of site-specific software.
g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.
2) Frequency of testing of installed components.
3) Frequency of inspection of installed components.
4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

h. Manufacturer's required maintenance related to system warranty requirements.
i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

B. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.

B. Automatic sensitivity control of certain smoke detectors.

C. All components provided shall be listed for use with the selected system.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Combustible gas detectors.
6. Automatic sprinkler system water flow.
7. Fire-extinguishing system operation.
8. Fire standpipe system.
9. Dry system pressure flow switch.
10. Fire pump running.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
7. Activate smoke-control system (smoke management) at firefighters' smoke-control system panel.
8. Close smoke dampers in air ducts of designated air-conditioning duct systems.
9. Recall elevators to primary or alternate recall floors.
10. Activate elevator power shunt trip.
11. Activate emergency shutoffs for gas and fuel supplies.
12. Record events in the system memory.
13. Record events by the system printer.
14. Indicate device in alarm on the graphic annunciator.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system.
3. Elevator shunt-trip supervision.
4. Fire pump running.
5. Fire-pump loss of power.
6. Fire-pump power phase reversal.
7. Independent fire-detection and -suppression systems.
8. User disabling of zones or individual devices.
9. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
10. Hose cabinet door open.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
3. Record the event on system printer.
4. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
5. Transmit system status to building management system.
6. Display system status on graphic annunciator.

2.3 FIRE-ALARM CONTROL UNIT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Silent Knight 6820 EVS
   2. Edwards EST.
   3. JCI Simplex.
   4. Notifier.
   5. Siemens Industry, Inc.; Fire Safety Division.

B. General Requirements for Fire-Alarm Control Unit:

   1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

      a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
      b. Include a real-time clock for time annotation of events on the event recorder and printer.
      c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
      d. The FACP shall be listed for connection to a central-station signaling system service.
      e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

   2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
   3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and

supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, three lines of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class A.
2. Pathway Survivability: Level 1.
3. Install no more than 50 addressable devices on each signaling-line circuit.
4. Serial Interfaces:

    a. One dedicated RS 485 port for central-station/remote station operation using point ID DACT.
    b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
    c. One RS 232 port for PC configuration.

E. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

F. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

G. Elevator Recall:

1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:

    a. Elevator lobby detectors except the lobby detector on the designated floor.
    b. Smoke detector in elevator machine room.
    c. Smoke detectors in elevator hoistway.

2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.

3. Heat Detectors in an elevator shaft and elevator machine room shall shut down elevators associated with the location. Time delay is permitted for the time it takes for the elevator cab to travel from the top floor to the lowest recall level.

H. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.

I. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

J. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

K. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

L. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

M. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.

2. Battery calculation shall include a minimum 20 percent safety margin above the calculated amp-hour capacity required.

N. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Silent Knight 6820 EVS
2. Edwards EST.
3. JCI Simplex.
4. Notifier.
5. Siemens Industry, Inc.; Fire Safety Division.

B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
   1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
   2. Station Reset: Key-switch.
   3. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm, where applicable or as noted on plan drawings.

2.5 SYSTEM SMOKE DETECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Silent Knight 6820 EVS
2. Edwards EST.
3. JCI Simplex.
4. Notifier.
5. Siemens Industry, Inc.; Fire Safety Division.

B. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be standard addressable two-wire type in all applications and four-wire type for sounder or relay based operations.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
6. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
c. Multiple levels of detection sensitivity for each sensor, as recommended by manufacturer.

C. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity as recommended by manufacturer.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.6 HEAT DETECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Silent Knight 6820 EVS
2. Edwards EST.
3. JCI Simplex.
4. Notifier.
5. Siemens Industry, Inc.; Fire Safety Division.

B. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

C. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Silent Knight 6820 EVS
2. Edwards EST.
3. JCI Simplex.
4. Notifier.
5. Siemens Industry, Inc.; Fire Safety Division.

B. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

D. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:
   a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

2.8 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.9 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall or to circuit-breaker shunt trip for power shutdown.

1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:

1. Operate notification devices.
2. Operate solenoids for use in sprinkler service.

2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.11 DOCUMENTATION CABINET

A. All record documentation shall be stored in a documentation cabinet. Where the documentation cabinet is not in the same location as the main fire alarm control panel, the location shall be clearly identified at the main fire alarm control panel.

B. The cabinet shall be painted red and labeled “Fire Alarm System Record Documents”.

C. The record documentations shall size and housed at minimum the following list of documents:
1. Written brief narrative providing intent and system description.

2. Record as-built drawings.
3. Equipment technical data sheets.
4. Manufacturer’s published instructions, including operation and maintenance instructions.
5. Battery and voltage drop calculations.
6. For software-based system, a copy of site-specific software including specific instructions on how to obtain the means of system and software access (password).
7. Completed record of completion in accordance with NFPA 72.
8. Completed record of inspection and testing in accordance with NFPA 72.

2.12 NETWORK COMMUNICATIONS

A. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

B. Provide integration gateway using BACnet for connection to building automation system.

2.13 SYSTEM PRINTER

A. Printer shall be listed and labeled as an integral part of fire-alarm system.

2.14 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by device manufacturer.
2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in other section for "Seismic Controls for Communications Systems."

C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches (910 mm) from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

H. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

I. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

J. Visible Alarm-Indicating Devices: Install adjacent to each alarm horn and at least 6 inches (150 mm) below the ceiling. Install all devices at the same height unless otherwise indicated.

K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

A. Pathways shall be installed in EMT.

B. Exposed EMT shall be painted red enamel.

3.4 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in other section for "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
2. Smoke dampers in air ducts of designated HVAC duct systems.
3. Magnetically held-open doors.
4. Electronically locked doors and access gates.
5. Alarm-initiating connection to elevator recall system and components.
6. Alarm-initiating connection to activate emergency lighting control.
7. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.

8. Supervisory connections at valve supervisory switches.
9. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
10. Supervisory connections at elevator shunt-trip breaker.
11. Data communication circuits for connection to building management system.
12. Supervisory connections at fire-extinguisher locations.
13. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
14. Supervisory connections at fire-pump engine control panel.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in other section for "Identification for Communications Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

    a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 284621.11

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

C. Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials, dated July, 2023 and as amended.

D. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition. Alternate methods and/or materials may be submitted to the Architect for consideration. Those judged to be equal to that specified will receive written approval.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing below-grade improvements pertains to those items shown on the drawings, and those associated with the above grade improvements to be removed, if they impede the proposed work.
7. Disconnecting, capping or sealing, and removing site utilities and/or abandonment of utilities and appurtenances.
8. Temporary erosion and sedimentation control.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; and free of weeds, roots, toxic materials, or other non-soil materials.

D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated according to requirements in Section 015639 "Temporary Tree and Plant Protection.".

F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PROJECT CONDITIONS

A. Traffic: Conduct site-clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.

B. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.

1. Protect improvements on adjoining properties and on Owner’s property.
2. Restore damaged improvements to their original condition, as acceptable to property owners, in a timely manner and at no additional cost to the Owner.

C. Soil Erosion and Sediment Control: Soil erosion and sediment control measures are required for this site in accordance with the approved plans. Soil erosion and sediment control measures disturbed or damaged by clearing operations shall be restored to operating condition in accordance with the requirements of the approved plan before the end of the work day.

D. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

1. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.
2. Provide protection for roots over 1-1/2 inch in diameter that are cut during construction operations. Coat cut faces with an emulsified asphalt or other acceptable coating formulated to use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out, cover with earth as soon as possible.
3. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations in manner acceptable to Architect. Employ a licensed arborist to repair damage to trees and shrubs.
4. Replace trees that cannot be replaced and restored to full-growth status, as determined by arborist.

1.5 EXISTING SERVICES

A. General: Indicated locations are approximate, determine exact locations before commencing Work.

B. Arrange and pay for disconnecting, removing, capping, and plugging, utility services. Notify affected utility companies in advance and obtain approval before starting this Work.

C. Place markers to indicated location of disconnected services. Identify service lines and capping locations on Project Record Documents.

1.6 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.7 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.8 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Topsoil stripping and stockpiling program.

C. Rock stockpiling program.

D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.9 QUALITY ASSURANCE

A. Comply with standards of authorities having jurisdiction.

B. In the event of a discrepancy between the Project Specifications, Construction Documents, Baltimore County Standard Specifications and Details, or other guidelines set forth by the authorities having jurisdiction, the more stringent will apply.

C. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

D. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

1.10 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Utility Locator Service: Notify Miss Utility for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

F. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."

G. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. The contractor shall review the Construction Manager’s construction staging plan prior to beginning any construction.

B. Protect and maintain benchmarks and survey control points from disturbance during construction.

C. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."

D. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENT CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion and sediment control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion and sediment control measures during construction until permanent vegetation has been established.

D. With permission from Erosion & Sediment Control Inspector, remove erosion and sediment controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXISTING UTILITIES

A. The contractor will locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. The contractor will coordinate with owner and with approval arrange with utility companies to shut off indicated utilities.

B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect/Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

C. Excavate for and remove underground utilities indicated to be removed.

D. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and in Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition."

E. Abandonment or removal of certain underground pipe or conduits may be indicated on mechanical or electrical drawings and is included under work of related Section 024113. Removing abandoned underground piping or conduits interfering with construction shall be as follows:

a. Underground improvements shall be completely removed to a depth of two feet below indicated subgrade under structures and paving or finished grade in other areas or where it conflicts with proposed construction.
b. Pipes and other utilities indicated to be abandoned in place shall have open ends plugged with concrete for a minimum length of one foot. Structures, manholes, and other utility appurtenances shall be filled with compacted subgrade materials.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Remove roots larger than 2 inches (50.8 mm) in diameter. Grind down stumps, roots, obstructions, and debris to a minimum depth of 18 inches (457.2 mm) below proposed turf areas and a minimum of 36 inches (914.4 mm) below proposed paved or hardscape areas.
3. Use only hand methods or air spade for grubbing within protection zones.
4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding 8 inches loose depth, and thoroughly compact each layer to a density not less than 95 percent of the maximum dry density when tested in accordance with AASHTO T-180 within the building footprint and extending out ten feet (10') either side of the exterior wall lines. Beyond this zone, fill may be compacted to a density not less than 92 percent of the maximum dry density when tested in accordance with AASHTO T-180.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Topsoil: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 6 inches. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 1 inch in diameter, and without weeds, roots, and other objectionable material.

1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other waste materials. Remove heavy growths of grass from areas before stripping.

a. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.

2. Remove subsoil and non-soil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches (50.8 mm) in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 144 inches (3658 mm) or as indicated on the sediment control plans.
2. Do not stockpile topsoil within protection zones.
3. Stockpile surplus topsoil to allow for respreading deeper topsoil.
4. Dispose of unsuitable as specified in Section 31 23 00 – Excavating and Filling for disposal of waste material.

3.7 STOCKPILING ROCK

A. Remove from construction area naturally formed rocks that measure more than 1 foot (304.8 mm) across in least dimension. Do not include excavated or crushed rock.

1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than 2 inches (50.8 mm) in diameter; trash, debris, weeds, roots, and other waste materials.

B. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.

1. Limit height of rock stockpiles to 144 inches (3658 mm).
2. Do not stockpile rock within protection zones.
3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.

3.8 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of anti-rust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.
3. Removal of pavement, including base courses, sidewalk, curb, and combination curb and gutter, shall be for the full depth thereof.
4. The Contractor shall use suitable equipment, tools, and methods for cutting and trimming as well as removing the materials to the neat lines set by the Owner and shall not in any manner disturb or damage the sections of base or pavement to be salvaged.
5. Damage done by the Contractor’s equipment or methods to those areas designated for salvaging shall be replaced at the Contractor’s expense.
6. Where the old subgrade is satisfactory as to condition and elevation, special care shall be taken in the removal operation in order to avoid disturbing the old grade.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property in accordance with local regulations.

B. Burning on Owner’s Property: Burning is not permitted on Owner’s property.

C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

3.10 RECORD DRAWINGS

A. Survey and include on record drawings location and depth of all utilities encountered which have not been removed.

END OF SECTION

SECTION 31 20 00 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

C. Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials dated July, 2023 and as amended.

D. Manual on Uniform Traffic Control Devices for Streets and Highways, 2009 Edition and as amended.

E. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition. Alternate methods and/or materials may be submitted to the Architect for consideration. Those judged to be equal to that specified will receive written approval.

1.2 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and plants.
3. Excavating and backfilling for buildings and structures.
4. Drainage and moisture control fill course for concrete slabs-on-grade.
5. Subbase course for concrete walks and pavements.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.
8. Excavating and backfilling trenches within building lines.
9. Excavating well hole to accommodate elevator-cylinder assembly.

B. Related Requirements:

1. Section 01 32 00 "Construction Progress Documentation" and Section 01 32 33 "Photographic Documentation" for recording pre-excavation and earth-moving progress.
2. Section 31 10 00 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
3. Section 31 50 00 "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
4. Section 31 63 29 "Drilled Concrete Piers and Shafts" for excavation of shafts and disposal of surplus excavated material.
5. Section 32 92 00 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.

6. Section 32 93 00 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.
7. Section 01 77 00 “Closeout Procedures”

1.3 SOIL INVESTIGATION DATA

A. Investigation:

1. Soil and subsurface investigations were conducted at the site, the results of which are to be found in the boring logs report prepared by Findling Inc, dated November 22, 2023.

B. Subsurface Soil Data:

1. Data concerning subsurface materials or conditions, which is based upon test pits, or test borings, has been obtained by Owner, the Architect, and the Engineers for their own use in designing the project. Its accuracy or completeness is not guaranteed by the Owner, the Architect or the Engineers, and Contractor must assume all responsibility in excavating for this project and shall not rely on subsurface information obtained from Architect, or Engineers, or indirectly from the Owner. Bidders shall make their own investigation of existing subsurface conditions. Neither the Owner, the Architect, or the Engineers will be responsible in any way for additional compensation for excavation work performed under the Contract, due to Contractor's assumptions based on subsoil data prepared solely for the Owner, the Architects, and the Engineers, use.

C. A copy of the results of the subsurface investigation has been included under Section 00900, Available Information, for informational purposes only.

1.4 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Additional excavation: When excavation has reached required subgrade elevations, notify the Inspection Agency, who will make an inspection of conditions. The Contractor is responsible for scheduling the inspections such that there is no delay in the Project. If the Inspection Agency determines that bearing material at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and replace excavated material as directed by them.

2. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
3. Bulk Excavation: Excavation more than 10 feet (3 m) in width and more than 30 feet (9.1 m) in length.
4. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. (0.76 cu. m) for bulk excavation or 1/2 cu. yd. (0.38 cu. m) for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator, equivalent to Caterpillar Model No. 215-LC; equipped with a 42-inch- (1067-mm-) maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp (103-kW) flywheel power with bucket-curling force of not less than 28,700 lbf (127.7 kN) and stick-crowd force of not less than 18,400 lbf (81.8 kN) with extra-long reach boom.
2. Equipment for Bulk Excavation: Late-model, track-mounted loader, Caterpillar Model No. D-8N; rated at not less than 285-hp (212.5-kW) flywheel power and developing a minimum of 45,000-lbf (200.2-kN) breakout force with a general-purpose bare bucket.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct pre-excavation conference at Project site.

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:

a. Personnel and equipment needed to make progress and avoid delays.
b. Coordination of Work with utility locator service.
c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.

d. Extent of trenching by hand or with air spade.
e. Field quality control.

f. Confirmation that the contractor will provide required equipment for Bulk and Trench rock removal.

1.6 ACTION SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Test Reports: In addition to test reports required under field quality control, submit the following:

1. Laboratory analysis of each soil material proposed for fill and backfill from on-site and borrow sources.
2. One moisture density curve for each soil material.
3. Reports of actual unconfined compressive strength and/or results of bearing tests of each stratum tested.

C. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Warning tapes.

D. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches (304.8 by 304.8 mm).
2. Warning Tape: 12 inches (304.8 mm) long; of each color.

E. LEED Submittals: Comply with Section 01 81 13

1. SS Credit 2: Protect or Restore Habitat

a. Provide documentation that confirms all criteria listed in Part 2 of this Section is met for all imported soils.

1.7 QUALITY ASSURANCE

A. Codes and Standards: Perform earthwork complying with requirements of Baltimore County.

B. Testing and Inspection Service: The Contractor will employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soils to verify that soils comply with specified requirements and to perform required field and laboratory testing during earthwork operations. Check bearing capacities of excavated footings to confirm bearing capacity prior to installation of reinforcing steel and concrete.

1. The Agency's responsibilities shall include:

a. Having an Inspector present on-site during all earthwork operations and as a minimum from 7:00 a.m. to 5:00 p.m. during all earthwork and trenching operations.
b. Testing and approving all materials used for fill and/or backfill and borrow.
c. Testing and approving on-site and borrow topsoil for compliance with this specification.
d. Maintaining accurate records in regard to excavation and fill or backfill for approved undercutting or over-excavation.

e. Maintain accurate records in regards to rock excavation in open excavations and in trench excavations.

f. Approving all backfilling procedures and mechanical compaction equipment.
g. Verifying compaction by in-place density tests. Tests to be submitted to the Architect for review. A minimum of one (1) density test shall be performed for each 2,500 square feet of lift area or pavement area, or more often if directed by the Architect.
h. Inspect exposed subgrade after clearing and grubbing prior to preparation of site.
i. Observe and inspect all proofrolling operations and determine whether additional excavation and backfilling is required.
j. Inspect and test that no loose or soft pockets exist beneath the bearing surface. Approve the bearing surfaces or recommend undercutting and structural fills, as necessary.
k. Submitting weekly written reports as to the status of the fill. Submit a final report indicating that the fill meets the requirements of the Specifications.
l. Determine all earthwork quantities for which unit price payments apply.
m. Verify in-place compacted depth of topsoil.
n. Monitor the movement of settlement plates.

2. It shall be the responsibility of the Contractor to notify the Inspection Agency three days prior to the beginning of work so that the Inspection Agency can have a soils engineer and/or soils technician on the site during the work. All costs of this Inspection service incurred due to lack of coordination by the Contractor of the earthwork, causing unnecessary visits by the Inspection Agency, shall be paid for by the Contractor.

C. In the event of a discrepancy between the Project Specifications, Construction Documents, Baltimore County requirements, or other guidelines set forth by the authorities having jurisdiction, the more stringent will apply.

D. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

1.8 AS-BUILTS

A. The Contractor shall provide, and pay for, an as-built survey to verify that proposed elevations have been achieved. A 50-foot grid shall be staked on all areas to verify finish grade elevations. In addition to the grid, all swales shall have top and bottom located, grade breaks located, top and bottom of retaining walls, shall be surveyed. Building finished floor elevation shall be surveyed at a minimum of one opening per building side, where possible.

B. A final as-built survey drawing shall be submitted to the Engineer and Owner for their review and verification.

1.9 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify "Miss Utility" for area where Project is located before beginning earth-moving operations.

C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 01 50 00 "Temporary Facilities and Controls" and Section 31 10 00 "Site Clearing" are in place.

D. Do not commence earth-moving operations until plant-protection measures specified in Section 01 56 39 "Temporary Tree and Plant Protection" are in place.

E. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

F. Do not direct vehicle or equipment exhaust towards protection zones.

G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

H. Backfilling below-grade areas: The backfilling operation required to bring actual grades to the grade elevations shown on the drawings as proposed grades.

1. The borrow material shall be removed and then either stored or disposed. If the testing agency verifies that the borrow material complies with these specifications for backfill material, then the Contractor may use it to backfill this area to grade.
2. Note that high or low moisture contents do not render a soil as "unsuitable" as the contractor is wholly responsible for moisture conditioning of the soils (i.e., scarifying/loosening and wetting or drying). Undercuts will only be authorized if the soils remain unsuitable when the soil in question is at optimal moisture content.
3. All suitable materials removed in excavation shall be used in accordance with the provisions of this section. It shall be the obligation of the Contractor to utilize all suitable materials from excavation in the construction of fills throughout the entire area of the Contract.
4. Any additional backfill material necessary to complete this operation shall comply with these specifications.
5. This backfilling operation shall be the first earthwork operation performed on site after establishment of the sediment control devices.
6. All backfilling operations must be performed in accordance with the Geotechnical Engineer’s report, including undercut and all protective measures.

I. Site Information: Data in subsurface investigation reports was used for the basis of the design. The data in the subsurface investigation report is not a part of the Contract. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. The Owner, Architect or Engineers will not be responsible for interpretations or conclusions drawn from this data by the Contractor.

1. Additional test borings and other exploratory operations may be performed by the Contractor, at the Contractor’s option; however, no change in the Contract Sum will be authorized for such additional exploration. The contractor shall, at the request of the Owner and/or Architect, provide subsurface assumptions, cut & fill analysis and/or computer models used in generation of base bid earthwork quantities.

J. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Architect and then only after acceptable temporary utility services have been provided. If existing utilities are indicated to be abandoned, the Contractor shall remove such utility, if necessary, at no additional cost to the Owner.

1. Provide a minimum 48 hours notice to the Architect and receive written notice to proceed before interrupting any utility.

K. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shutoff services if lines are active.

L. Should uncharted or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

M. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights. Open trench excavations within the limits of the State right-of-way shall be protected in accordance with the requirements of applicable permits. Open excavation within the roadways shall be plated and shall be posted with warning devices in accordance with the Manual of Uniform Traffic Control Devices 2009 Version and as amended.

1. Perform excavation by hand within dripline of large trees to remain. Protect root systems from damage or dryout to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with moistened burlap.

N. Moisture Sensitive Soils:

1. The on-site founding materials are moisture sensitive and will be easily disturbed by excessive construction activity.
2. The exposed founding materials shall be protected against detrimental changes in engineering qualities as a result of disturbance from rain or frost.
3. Surface runoff shall be drained away from the excavations and not allowed to pond.
4. If possible, concrete shall be placed in the footings the same day the excavations are made, or the founding materials may be covered by mud mats in order to protect the founding soil from becoming saturated due to forecasted precipitation and/or disturbed due to excessive construction activity during the placement of steel reinforcement.
5. The presence of moisture sensitive fine-grained soils poses the potential for high moisture content. Soils may be found to be at or near their plastic limit; consequently, the on-site soils may require dicing, aeration, and/or manipulation to achieve efficient compaction.
6. Any regions exhibiting poor drainage characteristics, and low lying areas, shall be expected to display moisture contents, which are excessively high for normal earthwork operations.
7. Note that high or low moisture contents do not render a soil as "unsuitable" as the contractor is wholly responsible for moisture conditioning of the soils (i.e., scarifying/loosening and wetting or drying). Undercuts will only be authorized if the soils remain unsuitable when the soil in question is at optimal moisture content.
8. All suitable materials removed in excavation shall be used in accordance with the provisions of this section. It shall be the obligation of the Contractor to utilize all suitable materials from excavation in the construction of fills throughout the entire area of the Contract.
9. Any standing water shall be drained or pumped into approved sediment control facilities prior to commencement of earthwork

10. Excavations near to subgrade and all fills should be protected from traffic of heavy equipment, including heavy compaction equipment, when on-site soils exhibit high moisture contents, in order to minimize pumping and a generalized deterioration of these materials.

O. The Contractor is solely responsible for the protection of the sub-grade until it receives final surface treatment and shall maintain the sub-grade as suitable and acceptable to the Owner or Owner's Representative at all times. He shall be completely responsible for restoration or replacement of the sub-grade due to moisture damage, construction traffic, or any other cause. Repair or replacement of the sub-grade shall be performed at no additional cost to the Owner.

P. Rock Excavation: The Contractor shall provide the Owner with rock surface elevations that have been confirmed by the onsite geotechnical engineer for quantity verification prior to any rock removal. Upon completing the necessary rock removal, volume measurements must be quantified and confirmed by geotechnical engineer. Failure to provide required quantity confirmation will result in the material being classified as standard excavation.

1.10 PROTECTION OF PROPERTY

A. The Contractor shall be responsible for all damages caused by his work to adjoining property and/or buildings. Care shall also be exercised to prevent a nuisance to neighboring properties by uncontrolled drainage of water or airborne dust.

B. The Contractor is cautioned to avoid the disturbance of existing settlement plates installed. Highly visible protective measures should be taken to prevent disturbances. Any costs associated with corrective measures for a disturbed settlement plate will the responsibility of the contractor.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations Classification of materials shall be made by the Contractor's independent testing agency.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487, or a combination of these groups; free of rock or gravel larger than 3 inches (76.2 mm) in any dimension and 1.5 inches within the top 18 inches of fill, debris, waste, frozen materials, vegetation and other deleterious matter. The proposed fill soil should have a maximum dry density of no less than 120 pcf. GC and SC materials may be utilized as compacted structural fill if they contain less than 35% passing the No. 200 sieve and a Plasticity Index of less than 15.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487, or a combination of these groups. The soils classified as GC, SC, CL, ML; and CH/MH with a maximum Liquid Limit of 60% and Plasticity Index of 30% can be used as structural fills at depths greater than 4 ft below pavement subgrades and within non-structural areas. In addition, these soils can be used as a fill for site grading with a maximum dry density greater than 105 pcf.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with graded aggregate for subbase courses shall meet the requirements for G A S/B as shown in Table 312300-1. RC-6 is not acceptable.

Table 31 23 00-1

SIEVES		**MASS PERCENT PASSING**	
mm	Standard	BRG S/B	G A S/B
100	4 in.		
90	3 ½ in.		
63	2 ½ in.	100	
50	2 in.		100, ± 3
37.5	1 ½ in.		90 - 100, ± 5
25	1 in.	90 – 100	
19	¾ in.		
12.5	½ in.	60 - 100	
9.5	3/8 in.		
4.75	#4		30 - 60, ± 10
2.36	#8		
2.0	#10	35 - 90	
0.60	#30		
0.425	#40	20 - 55	
0.075	#200	5 - 25	0 - 12, ± 5

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch (38.1-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

F. Engineered Fill: Subbase or base materials.

G. Bank Run Gravel for subbases: Bank Run Gravel for subbase courses shall meet the requirements for BRG S/B as shown in Table 31 23 00-1.

H. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch (25.4-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

I. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (38.1-mm) sieve and zero to 5 percent passing a No. 8 (2.36-mm) sieve.

J. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25.4-mm) sieve and zero to 5 percent passing a No. 4 (4.75-mm) sieve.

K. Sand: ASTM C33/C33M; fine aggregate.

L. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

M. Imported Soils: Comply with the following criteria:

1. Original function is comparable to reuse function
2. Not classified as prime farmland, unique farmland or farmland of statewide or local importance.
3. Not extracted from a greenfield site.
4. Does not include sphagnum peat moss.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: As follows:
   a. Grab Tensile Strength: 157 lbf (698.4 N); ASTM D4632.
   b. Sewn Seam Strength: 142 lbf (631.6 N); ASTM D4632.
   c. Tear Strength: 56 lbf (249.1 N); ASTM D4533.
   d. Puncture Strength: 56 lbf (249.1 N); ASTM D4833.
2. Apparent Opening Size: No. 40 (0.425-mm) sieve, maximum; ASTM D4751.
3. Permittivity: 0.5 per second, minimum; ASTM D4491.
4. UV Stability: 50 percent after 500 hours' exposure; ASTM D4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: As follows:
   a. Grab Tensile Strength: 247 lbf (1098.7 N); ASTM D4632.
   b. Sewn Seam Strength: 222 lbf (987.5 N); ASTM D4632.
   c. Tear Strength: 90 lbf (400.3 N); ASTM D4533.
   d. Puncture Strength: 90 lbf (400.3 N); ASTM D4833.
2. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D4751.
3. Permittivity: 0.02 per second, minimum; ASTM D4491.
4. UV Stability: 50 percent after 500 hours' exposure; ASTM D4355.

2.3 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (152.4 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with

metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (762 mm) deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

D. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, and sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

1. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water to be removed from excavation to collecting or runoff areas. Do not use foundation or pipeline excavations as temporary drainage ditches.

E. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

F. During Construction, the grading operations shall be performed in a manner such that the excavation will be well drained at all times. When necessary, excavations shall be drained to sumps, which shall be pumped continuously, if required, to an approved sediment control device. The Contractor shall maintain and keep all ditches open and free from soil and debris while in service or until final acceptance of the work, and all grading shall be done on neat, regular lines conforming to the sections and contours shown on the plans. All work done in proper sequence with all other associated operations. Before slab or surfacing is placed, all drainage facilities shall be installed which are required to permit free and uninterrupted flow of the surface and underground water from the site or to pumping sumps, etc.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation. Excavation, including undercut, shall be performed in accordance with the Geotechnical Engineer's report.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.

    a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.

2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:

    a. 24 inches (609.6 mm) outside of concrete forms other than at footings.
    b. 12 inches (304.8 mm) outside of concrete forms at footings.
    c. 6 inches (152.4 mm) outside of minimum required dimensions of concrete cast against grade.
    d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
    e. 6 inches (152.4 mm) beneath bottom of concrete slabs-on-grade.
    f. 6 inches (152.4 mm) beneath pipe in trenches and the greater of 24 inches (609.6 mm) wider than pipe or 42 inches (1066.8 mm) wide.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25.4 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Section 01 56 39 "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (304.8 mm) higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches (304.8 mm) each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches (152.4 mm) in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches (152.4 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
4. Excavate trenches 6 inches (152.4 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Section 01 56 39 "Temporary Tree and Plant Protection."

3.8 SUBGRADE INSPECTION

A. Notify Testing Agent when excavations have reached required subgrade.

B. When Testing Agent determines that unforeseen unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed by the Testing Agent.

1. Unforeseen additional excavation and replacement material will be paid according to the Contract provisions for changes in Work.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes) to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (4.8 km/h).
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect.

B. In locations other than those above, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by the Architect.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.

7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches (457.2 mm) of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 03 30 00 "Cast-in-Place Concrete."

D. Trenches under Roadways: Provide 4 inch (101.6 mm) thick, concrete-base slab support for piping or conduit less than 30 inches (762 mm) below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches (101.6 mm) of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 03 30 00 "Cast-in-Place Concrete."

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of subbase material, free of particles larger than 1 inch (25.4 mm) in any dimension, to a height of 12 inches (304.8 mm) over the pipe or conduit.

a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

G. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

H. Warning Tape: Install warning tape directly above utilities, 12 inches (304.8 mm) below finished grade, except 6 inches (152.4 mm) below subgrade under pavements and slabs.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.

3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry density.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches (203.2 mm) in loose depth for material compacted by heavy compaction equipment and not more than 4 inches (101.6 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure. Compacted structural fill should be placed at least 5 ft beyond the edge of the building.

C. Compact soil materials to not less than the following percentages of maximum dry density according to ASTM D1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (304.8 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under turf or unpaved areas, scarify and recompact top 6 inches (152.4 mm) below subgrade and compact each layer of backfill or fill soil material at 85 percent.
3. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 2 inches (50.8 mm).
2. Walks: Plus or minus 2 inches (50.8 mm).
3. Pavements: Plus or minus 1 inch (25.4 mm).

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (12.7 mm) when tested with a 10-foot (3-m) straightedge.

3.17 SUBSURFACE DRAINAGE

A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6 inch (152.4 mm) course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches (304.8 mm) of filter material, placed in compacted layers 6 inches (152.4 mm) thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches (152.4 mm).

1. Compact each filter material layer to 85 percent of maximum dry density according to ASTM D698.

B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches (304.8 mm) of final subgrade, in compacted layers 6 inches (152.4 mm) thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches (152.4 mm).

1. Compact each filter material layer to 85 percent of maximum dry density according to ASTM D698 with a minimum of two passes of a plate-type vibratory compactor.

3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subbase course under hot-mix asphalt pavement.
3. Shape subbase course and base course to required crown elevations and cross-slope grades.
4. Place subbase course and base course 6 inches (152.4 mm) or less in compacted thickness in a single layer.
5. Place subbase course and base course that exceeds 6 inches (152.4 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (152.4 mm) thick or less than 3 inches (76.2 mm) thick.
6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness. The aggregate base course should meet the specifications of MSHA GA Base or CR-6, and be compacted to at least 97% of the maximum dry density per AASHTO T180. The moisture content of the material shall be maintained within 2% of the material’s optimum moisture content. Approved subgrade consists of a firm and unyielding proof rolled soil subgrade or compacted select fill. For the compacted select fill, the top 1 ft of select fill material shall be compacted to a minimum of 97% of the maximum dry density and the material below the top 1 ft shall be compacted to a minimum of 92% of the maximum dry density as per AASHTO T180, with a moisture content within 2% of optimum.

3.19 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place drainage course 6 inches (152.4 mm) or less in compacted thickness in a single layer.
3. Place drainage course that exceeds 6 inches (152.4 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (152.4 mm) thick or less than 3 inches (76.2 mm) thick.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.20 FIELD QUALITY CONTROL

A. Special Inspections: Contractor will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
2. Determine that fill material classification and maximum lift thickness comply with requirements.
3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Contractor will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. The Inspection Agency shall inspect the site after it has been stripped and excavated. Determine if undercutting or in-place densification is necessary to prepare the subgrade for fill placement or for footing, slab or pavement support.

D. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

E. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

F. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (0.005 ac.) or less of paved area or building slab but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet (30.5 m) or less of wall length but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (45.7 m) or less of trench length but no fewer than two tests.

G. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

H. Tests for Displacement of Drains: Drains will be checked by the Inspection Agency Architect to determine whether any displacement of pipe has occurred after trench has been backfilled to about two feet above pipe and compacted as specified. These will be as follows: A light will be flashed between manholes, or, if manholes have not yet been constructed between locations of manholes, by means of flashlight or by reflecting sunlight with a mirror. If illuminated interior of pipe lines shows poor alignment, displaced pipe, or any other defects designated by Architect, it shall be corrected by the Contractor at no additional cost to the Owner.

3.21 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. There will be no measurement of the following:

1. Excavation for site grading to accommodate proposed grades and for all materials above the indicated undercut elevation.
2. Excavation to rough grading required by indicated elevations within neat lines of building footings.
3. Excavation to bottoms of utility trenches.
4. Excavation to rough grades of miscellaneous structures.
5. Over-excavation.

6. Unauthorized excavation.
7. Borrow material.
8. Rehandling, and drying and/or wetting of on-site soils.
9. Select backfill material as indicated on plans.
10. Stripping of all organic material.

B. Measurement will be made of the following:

1. Authorized over-excavation or undercutting required to remove unsatisfactory subgrade material which occurs below indicated subgrade elevations, miscellaneous structures, except where noted to be removed as part of the drawings.
2. Measurement of Rock Excavation in Open Excavation as defined herein and approved by the Inspection Agency, including excavation; disposal; filling and/or backfilling, if required; and compaction shall be on a Cubic Yard basis.
3. Measurement of Rock Excavation in Excavation Trenches and Pits defined herein and approved by the Inspection Agency, including excavation; disposal; filling and/or backfilling, if required; and compaction shall be on a Cubic Yard basis.

4.2 PAYMENT

A. For items not measured: All work shall be paid for under the Base Bid Price.

B. Authorized over-excavation or undercutting, including excavation, backfilling, compacting, and disposal of unsatisfactory material shall be paid for at the unit price per cubic yard as submitted on the Bid Form.

C. Rock Excavation in Open Excavation as defined herein and approved by the Inspection Agency. Excavations for this contract is to include 500 cubic yards of Rock Excavation in Open Excavations under the Base Bid Price. Final Payment will be made as follows:

1. If the final quantity of Rock Excavation in Open Excavations is more than 500 cubic yards, Payment will be made for the cubic yards exceeding 500 cubic yards at the unit price per cubic yard indicated in the Proposal Form.
2. If the final quantity of Rock Excavation in Open Excavation is less than 500 cubic yards, the Contractor's Base Bid price will be reduced as determined by the difference between 500 cubic yards and the actual measured quantity times the unit price per cubic yards, indicated in the proposal Price.

D. Rock Excavation in Trench Excavations and Pits, as defined herein and approved by the Inspection Agency in this Contract, is to include 500 cubic yards of Rock excavation in Trench Excavation and Pits under the Basic Bid Price. Final Payment will be made as follows:

1. If the final quantity of Rock Excavation in Trench Excavation and Pits is more than 500 cubic yards, Payment will be made for the cubic yards exceeding 500 cubic yards at the unit price per cubic yard, indicated in the Proposal Form.
2. If the final quantity of Rock Excavation in Trench Excavations and Pits is less than 500 cubic yards, the Contractor's Base Bid Price will be reduced as determined by the difference between 500 cubic yards and the actual measured quantity times the unit price per cubic yards, indicated in the Proposal Form.

END OF SECTION

SECTION 31 23 19 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

1.2 SUMMARY

A. Section includes construction dewatering.

B. Related Requirements:

1. Section 01 32 33 "Photographic Documentation" for recording preexisting conditions and dewatering system progress.
2. Section 31 20 00 "Earth Moving" for excavating, backfilling, site grading, and controlling surface-water runoff and ponding.

1.3 ALLOWANCES

A. Dewatering observation wells are part of dewatering allowance.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review condition of site to be dewatered including coordination with temporary erosion-control measures and temporary controls and protections.
3. Review geotechnical report.
4. Review proposed site clearing and excavations.
5. Review existing utilities and subsurface conditions.
6. Review observation and monitoring of dewatering system.

1.5 ACTION SUBMITTALS

A. Shop Drawings: For dewatering system, prepared by or under the supervision of a qualified professional engineer.

1. Include plans, elevations, sections, and details.
2. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.

3. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
4. Include written plan for dewatering operations including sequence of well and well-point placement coordinated with excavation shoring and bracings and control procedures to be adopted if dewatering problems arise.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and professional engineer.

B. Field quality-control reports.

C. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.

D. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that specializes in dewatering work.

1.8 FIELD CONDITIONS

A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.
2. The geotechnical report is included elsewhere in Project Manual.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.
2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
3. Prevent surface water from entering excavations by grading, dikes, or other means.

4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
5. Remove dewatering system when no longer required for construction.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water and debris disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Protect and maintain temporary erosion and sedimentation controls, which are specified in Section 01 50 00 "Temporary Facilities and Controls," during dewatering operations.

3.2 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.
2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.

C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on a continuous basis if any part of system becomes inadequate or fails.

3.3 OPERATION

A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

B. Operate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
3. Maintain piezometric water level a minimum of 24 inches (609.6 mm) below bottom of excavation.

C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

D. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches (914.4 mm) below overlying construction.

3.4 FIELD QUALITY CONTROL

A. Observation Wells: Provide observation wells or piezometers, take measurements, and maintain at least the minimum number indicated; additional observation wells may be required by authorities having jurisdiction.

1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

B. Survey-Work Benchmarks: Resurvey benchmarks monthly during dewatering and maintain an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

C. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

D. Prepare reports of observations.

3.5 PROTECTION

A. Protect and maintain dewatering system during dewatering operations.

B. Promptly repair damages to adjacent facilities caused by dewatering.

END OF SECTION

SECTION 31 25 00 - SOIL EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. 2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control, and as amended.

C. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

D. Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials, dated July, 2023 and as amended.

1.2 SUMMARY

A. The extent of soil erosion and sediment control facilities is shown on the Erosion and Sediment Control Plans, approved by the Baltimore County Soil Conservation District.

B. The contractor will assume responsibility for the erosion and sediment controls that currently exist on the site at the time the contract is executed, and will be responsible for the conversion of the erosion and sediment controls from their existing state to those outlined in the construction documents. Additionally, the contractor will also be responsible for all erosion and sediment controls outlined within the contract documents and/or any additional erosion and sediment controls required by the inspector at no additional cost to the Owner.

1.3 QUALITY ASSURANCE

A. Comply with local codes where applicable and with the requirements of all permits.

B. Comply with the provisions outlined in Division 1.

PART 2 - PRODUCTS

2.1 MATERIALS REQUIREMENTS

A. Material requirements are specified on the drawings.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation of the soil erosion and sediment control facilities shall be as shown and specified on the Sediment/Erosion Control Plans and Detail sheets of the Contract Drawings.

3.2 TIMING

A. All perimeter control shall be installed and approved by the Sediment Control Inspector as specified in the “Sequence of Construction” on the Contract Drawings.

3.3 MAINTENANCE

A. All soil erosion and sediment control measures shall be maintained continuously during the construction period.

B. Soil erosion and sediment control measures shall be inspected daily, and any measure which has been disturbed or damaged shall be repaired and restored to operating condition in accordance with the approved plan before the end of each workday at no additional cost to the Owner.

3.4 REMOVAL

A. Soil erosion and sediment control measures shall not be removed until the removal has been authorized by the Sediment Control Inspector.

END OF SECTION

SECTION 31 31 16 - TERMITE CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

1.2 SUMMARY

A. Section Includes:

1. Soil treatment.
2. Wood treatment.
3. Bait-station system.
4. Metal mesh barrier system.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for wood preservative treatment by pressure process.
2. Section 07 62 00 "Sheet Metal Flashing and Trim" for custom-fabricated, metal termite shields.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components, and profiles for termite control products.
2. Include the EPA-Registered Label for termiticide products.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each type of termite control product.

C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:

1. Date and time of application.
2. Moisture content of soil before application.
3. Termiticide brand name and manufacturer.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes used, and rates of application.
6. Areas of application.

7. Water source for application.

D. Wood Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:

1. Date and time of application.
2. Termiticide brand name and manufacturer.
3. Quantity of undiluted termiticide used.
4. Dilutions, methods, volumes used, and rates of application.
5. Areas of application.

E. Bait-Station System Installation Report: After installation of bait-station system is completed, submit report for Owner's records and include the following:

1. Location of areas and sites conducive to termite feeding and activity.
2. Plan drawing showing number and locations of bait stations.
3. Dated report for each monitoring and inspection occurrence, indicating level of termite activity, procedure, and treatment applied before time of Substantial Completion.
4. Termiticide brand name and manufacturer.
5. Quantities of nontoxic termite bait used.
6. Schedule of inspections for one year from date of Substantial Completion.

F. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who employs workers trained and approved by manufacturer to install manufacturer's products.

1.7 FIELD CONDITIONS

A. Soil Treatment:

1. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
2. Related Work: Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.8 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work consisting of applied soil termiticide treatment will prevent infestation of subterranean termites, including Formosan termites (Coptotermes formosanus). If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Three years from date of Substantial Completion.

B. Wood Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work consisting of applied wood termiticide treatment will prevent infestation of subterranean termites, including Formosan termites (Coptotermes formosanus). If subterranean termite damage is discovered during warranty period, repair or replace damage caused by termite infestation and treat replacement wood.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain termite control products from single source.

2.2 SOIL TREATMENT

A. Termiticide: EPA-Registered termiticide acceptable to authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation.

1. Service Life of Treatment: Soil treatment termiticide that is effective for not less than three years against infestation of subterranean termites.

2.3 WOOD TREATMENT

A. Borate: EPA-Registered borate termiticide acceptable to authorities having jurisdiction, in an aqueous solution for spray application and a gel solution for pressure injection, formulated to prevent termite infestation in wood.

2.4 BAIT-STATION SYSTEM

A. Description: EPA-Registered system acceptable to authorities having jurisdiction. Provide bait stations based on the dimensions of building perimeter indicated on Drawings, according to product's EPA-Registered Label and manufacturer's written instructions.

2.5 METAL MESH BARRIER SYSTEM

A. Stainless-Steel Mesh: 0.025 inch by 0.018 inch (0.64 mm by 0.46 mm) mesh of 0.08 inch (2.0 mm) diameter, stainless-steel wire, Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Prepare work areas according to the requirements of authorities having jurisdiction and according to manufacturer's written instructions before beginning application and installation of termite control treatment(s). Remove extraneous sources of wood cellulose and other edible materials, such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be

treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

1. Fit filling hose connected to water source at the site with a backflow preventer, according to requirements of authorities having jurisdiction.

3.3 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.

1. Slabs-on-Grade and Basement Slabs: Underground supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.
3. Crawlspaces: Soil under and adjacent to foundations. Treat adjacent areas, including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
4. Masonry: Treat voids.
5. Penetrations: At expansion joints, control joints, and areas where slabs and below-grade walls will be penetrated.

B. Post warning signs in areas of application.

C. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.4 APPLYING WOOD TREATMENT

A. Wood Treatment: Apply wood treatment after framing, sheathing, and exterior weather protection is completed but before electrical and mechanical systems are installed.

B. Application: Mix borate wood treatment solution to a uniform consistency. Apply treatment at the product's EPA-Registered Label volume and rate for the maximum borate concentration allowed for each specific use so that wood framing, sheathing, siding, and structural members subject to infestation receive treatment. Apply treatment to the height of 8 feet (2438 mm) above grade.

1. Framing and Sheathing: Apply termiticide solution by spray to bare wood and with complete coverage.
2. Heavy Wood Members: For wood greater than 4 inches (101.6 mm) thick, inject termiticide gel solution under pressure into holes of size and spacing required by manufacturer for treatment.
3. Exterior Uncoated Wood Trim and Siding: Apply termiticide solution to bare wood only when forecasted weather conditions indicate no precipitation or fog before application of seal coat. After 48 hours, verify that surface is sufficiently dry for seal coat and apply seal coat of paint as specified in Section 09 91 13 "Exterior Painting.".

3.5 INSTALLING BAIT-STATION SYSTEM

A. Bait-Station System: Install during construction to determine areas of termite activity.

B. Place bait stations according to product's EPA-Registered Label and manufacturer's written instructions, in the following locations:

1. Conducive sites and locations indicated on Drawings.
2. In and around infested trees and stumps.
3. In mulch beds.
4. Where wood directly contacts soil.
5. Areas of high soil moisture.
6. Near irrigation sprinkler heads.
7. Each area where roof drainage system, including downspouts and scuppers, drains to soil.
8. Along driplines of roof overhangs without gutters.
9. Where condensate lines from mechanical equipment drip or drain to soil.
10. At plumbing penetrations through ground-supported slabs.
11. Other sites and locations as determined by licensed Installer.

C. Spacing: Place bait stations according to manufacturer's written instructions and at a frequency no less than the following:

1. One cluster of bait stations per 20 linear feet (6.1 linear meters), with no fewer than three bait stations per cluster.

3.6 INSTALLING METAL MESH BARRIER SYSTEM

A. Install metal mesh barrier system to provide a continuous barrier to entry of subterranean termites, according to manufacturer's written instructions.

1. Fit mesh tightly around pipes and other penetrations and terminate at slab and foundation perimeters.
2. Install mesh under the perimeter of concrete slab edges and joints after vapor retarder and reinforcing steel are in place.

3.7 PROTECTION

A. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

B. Protect termiticide solution dispersed in treated soils and fills from being diluted by exposure to water spillage or weather until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

3.8 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of termite-control-treatment Installer. Include monthly maintenance as required for proper performance according to the product's EPA-Registered Label and manufacturer's written instructions. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

B. Continuing Maintenance Proposal: Provide from termite-control-treatment Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1. Include annual inspection for termite activity and effectiveness of termite treatment according to manufacturer's written instructions.

END OF SECTION

SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

C. Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials, dated July, 2023 and as amended.

D. 2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control, and as amended.

1.2 SUMMARY

A. Section includes temporary excavation support and protection systems.

B. Related Requirements:

1. Section 01 32 33 "Photographic Documentation" for recording preexisting conditions and excavation support and protection system progress.
2. Section 31 20 00 "Earth Moving" for excavating and backfilling, for controlling surface-water runoff and ponding, and for dewatering excavations.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review geotechnical report.
2. Review existing utilities and subsurface conditions.
3. Review coordination for interruption, shutoff, capping, and continuation of utility services.
4. Review proposed excavations.
5. Review proposed equipment.
6. Review monitoring of excavation support and protection system.
7. Review coordination with waterproofing.
8. Review abandonment or removal of excavation support and protection system.

1.4 ACTION SUBMITTALS

A. Delegated-Design Submittal: For excavation support and protection systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Land surveyor.
2. Professional Engineer: Experience with providing delegated-design engineering services of the type indicated, including documentation that engineer is licensed in the State of Maryland.

B. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.

1.6 CLOSEOUT SUBMITTALS

A. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.7 FIELD CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility-serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Architect and Owner no fewer than two days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Architect's and Owner's written permission.

B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks, and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design excavation support and protection systems to resist all lateral loading and surcharge, including but not limited to, retained soil, groundwater pressure, adjacent building loads, adjacent traffic loads, construction traffic loads, material stockpile loads, and seismic loads, based on the following:

1. Compliance with OSHA Standards and interpretations, 29 CFR 1926, Subpart P.
2. Compliance with AASHTO Standard Specification for Highway Bridges or AASHTO LRFD Bridge Design Specification, Customary U.S. Units.
3. Compliance with requirements of authorities having jurisdiction.
4. Compliance with utility company requirements.
5. Compliance with railroad requirements.

2.2 MATERIALS

A. Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A36/A36M, ASTM A690/A690M, or ASTM A992/A992M.

C. Steel Sheet Piling: ASTM A328/A328M, ASTM A572/A572M, or ASTM A690/A690M; with continuous interlocks.

1. Corners: Site-fabricated mechanical interlock.

D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.

E. Shotcrete: Comply with Section 033713 "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.

F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

G. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), deformed.

H. Tiebacks: Steel bars, ASTM A722/A722M.

I. Tiebacks: Steel strand, ASTM A416/A416M.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.

3.2 INSTALLATION - GENERAL

A. Locate excavation support and protection systems clear of permanent construction, so that construction and finishing of other work is not impeded.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.

3.3 SOLDIER PILES AND LAGGING

A. Install steel soldier piles before starting excavation.

1. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement.
2. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging.
3. Accurately align exposed faces of flanges to vary not more than 2 inches (50.8 mm) from a horizontal line and not more than 1:120 out of vertical alignment.

B. Install wood lagging within flanges of soldier piles as excavation proceeds.

1. Trim excavation as required to install lagging.
2. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.4 SHEET PILING

A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock vertical edges to form a continuous barrier.

B. Accurately place the piling using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer.

1. Limit vertical offset of adjacent sheet piling to 60 inches (1524 mm).
2. Accurately align exposed faces of sheet piling to vary not more than 2 inches (50.8 mm) from a horizontal line and not more than 1:120 out of vertical alignment.

C. Cut tops of sheet piling to uniform elevation at top of excavation.

3.5 TIEBACKS

A. Drill, install, grout, and tension tiebacks.

B. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.

1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.

C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 BRACING

A. Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
2. Install internal bracing if required to prevent spreading or distortion of braced frames.
3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.7 MAINTENANCE

A. Monitor and maintain excavation support and protection system.

B. Prevent surface water from entering excavations by grading, dikes, or other means.

C. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

3.8 FIELD QUALITY CONTROL

A. Survey-Work Benchmarks: Resurvey benchmarks weekly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open.

1. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions.
2. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.

C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.9 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures.

1. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
2. Remove excavation support and protection systems to a minimum depth of 48 inches (1219 mm) below overlying construction, and abandon remainder.
3. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
4. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

END OF SECTION

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

C. Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials, dated July, 2023 and as amended.

D. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition. Alternate methods and/or materials may be submitted to the Architect for consideration. Those judged to be equal to that specified will receive written approval.

1.2 SUMMARY

A. Section Includes:

1. Hot-mix asphalt paving.
2. Hot-mix asphalt overlay.
3. Cold milling of existing asphalt pavement.
4. Hot-mix asphalt patching.
5. Asphalt curbs.
6. Asphalt traffic-calming devices.
7. Asphalt surface treatments.

B. Related Requirements:

1. Section 02 41 19 "Selective Demolition" for demolition and removal of existing asphalt pavement.
2. Section 31 20 00 "Earth Moving" for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
3. Section 32 13 13 "Concrete Paving" for concrete pavement and for separate concrete curbs, gutters, and driveway aprons.
4. Section 32 13 73 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.
5. Section 32 14 00 "Unit Paving" for bituminous setting bed for pavers and for stone and precast concrete curbs.
6. Section 32 17 23: "Pavement Markings".

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

    a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
    b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.4 SYSTEM DESCRIPTION

A. Provide hot-mix asphalt pavement according to the materials, workmanship, and other applicable requirements of the Baltimore County Standards and the Standard Specifications for Construction and Materials of the Maryland Department of Transportation, State Highway Administration, latest edition, are hereby by reference made a part of these specifications where applicable with the exception of “Method of Measurement and Basis of Payment”. No adjustments to contract will be made as a result of material escalation.

B. Bituminous concrete pavement shall consist of aggregate asphalt mixed and constructed in accordance with these specifications and placed to the depth, grade, and cross section shown on the Construction Details.

1.5 ACTION SUBMITTALS

A. Product Data: Include technical data and tested physical and performance properties.

1. Herbicide.
2. Paving geotextile.
3. Joint sealant.

B. Hot-Mix Asphalt Designs:

1. Certification, by authorities having jurisdiction, of approval of each hot-mix asphalt design proposed for the Work.
2. For each hot-mix asphalt design proposed for the Work.

C. Samples for Verification: For the following product, in manufacturer's standard sizes unless otherwise indicated:

1. Paving Geotextile: 12 by 12 inches (304.8 by 304.8 mm) minimum.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For paving-mix manufacturer and testing agency.

B. Material Certificates:

1. Aggregates.
2. Asphalt binder.
3. Asphalt cement.

4. Cutback prime coat.
5. Emulsified asphalt prime coat.
6. Tack coat.
7. Fog seal.

8. Undersealing asphalt.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. The paving-mix manufacturer shall be a registered and approved paving mix manufacturer with the Baltimore County Department of Public Works or with the Maryland State Highway Administration
2. The paving-mix manufacturer shall be registered with and approved by Maryland Department of Transportation State Highway Administration.

B. Installer Qualifications: Engage an experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

C. Testing Agency Qualifications: Qualified in accordance with ASTM D3666 for testing indicated.

D. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended, of for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

E. Asphalt-Paving Publication: Comply with AI's "The Asphalt Handbook", except where more stringent requirements are indicated.

F. In the event of a discrepancy between the Project Specifications, Construction Documents, Baltimore County Standard Specifications and Details, or other guidelines set forth by the authorities having jurisdiction, the more stringent will apply

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
2. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
3. Slurry Coat: Comply with weather limitations in ASTM D3910.
4. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use locally available materials and gradation that exhibit a satisfactory record of previous installations. Bituminous concrete shall meet the requirements of the S.H.A. Specifications, Section 904, as later specified herein or as indicated on the drawings.

B. Coarse Aggregate: ASTM D692/D692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: ASTM D6373 binder designation PG 64-22.

B. Asphalt Cement: ASTM D3381/D3381M for viscosity-graded material, ASTM D946/D946M for penetration-graded material.

C. Emulsified Asphalt Prime Coat: ASTM D977 emulsified asphalt, or ASTM D2397/D2397M cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

D. Tack Coat: ASTM D977 emulsified asphalt, or ASTM D2397/D2397M cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

E. Fog Seal: ASTM D977 emulsified asphalt, or ASTM D2397/D2397M cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

F. Water: Potable.

G. Undersealing Asphalt: ASTM D3141/D3141M; pumping consistency.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

B. Sand: ASTM D1073, Grade No. 2 or No. 3.

C. Paving Geotextile: AASHTO M 288 paving fabric; nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

D. Joint Sealant: ASTM D6690, Type I, hot-applied, single-component, polymer-modified bituminous sealant.

2.4 MIXES

A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course: Hot Mix Asphalt Superpave 12.5 mm – PG 64-22 Level 2
3. Surface Course: Hot Mix Asphalt Superpave 9.5 mm – PG 64-22 Level 2.

B. Emulsified-Asphalt Slurry: ASTM D3910, Type 1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.

B. Notify Architect in writing of any unsatisfactory conditions. Do not begin paving installation until these conditions have been satisfactorily corrected.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (4.8 km/h).
2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

3.3 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement, including hot-mix asphalt and as necessary, unbound-aggregate base course, by cold milling to grades and cross sections indicated.

1. Mill to a depth of 2 inches (50.8 mm).
2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.

4. Repair or replace curbs, driveway aprons, manholes, and other construction damaged during cold milling.

5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Patch surface depressions deeper than 1 inch (25.4 mm) after milling, before wearing course is laid.
7. Handle milled asphalt material in accordance with approved waste management plan required in Section 01 74 19 "Construction Waste Management and Disposal."
8. Keep milled pavement surface free of loose material and dust.
9. Do not allow milled materials to accumulate on-site.

3.4 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (304.8 mm) into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Undersealing: Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd. (0.23 to 0.68 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Placing Single-Course Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

E. Placing Two-Course Patch Material: Partially fill excavated pavements with hot-mix asphalt base course mix and, while still hot, compact. Cover asphalt base course with compacted layer of hot-mix asphalt surface course, finished flush with adjacent surfaces.

3.5 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25.4 mm) in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches (76.2 mm) thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch (6.4 mm).

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch (6.4 mm) wide. Fill flush with surface of existing pavement and remove excess.

3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch (6.4 mm) wide. Fill flush with surface of existing pavement and remove excess.

3.6 SURFACE PREPARATION

A. Ensure that prepared subgrade has been proof-rolled and is ready to receive paving. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces.

1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Herbicide Treatment: Apply herbicide in accordance with manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.
2. Protect primed substrate from damage until ready to receive paving.

C. Cutback Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. (0.68 to 2.3 L/sq. m). Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

D. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth (0.45 to 1.36 L/sq. m per 25.4 mm depth). Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

E. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.23 to 0.68 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.7 INSTALLATION OF PAVING GEOTEXTILE

A. Apply tack coat uniformly to existing pavement surfaces at a rate of 0.20 to 0.30 gal./sq. yd. (0.91 to 1.36 L/sq. m).

B. Place paving geotextile promptly in accordance with manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches (101.6 mm) and transverse joints 6 inches (152.4 mm).

C. Protect paving geotextile from traffic and other damage, and place hot-mix asphalt overlay the same day.

3.8 HOT-MIX ASPHALT PLACEMENT

A. Bituminous concrete shall not be placed when the ambient air and surface temperature is below 60° F. When the surface temperature falls below these limits, material enroute may be placed at the risk of the Contractor.

B. Apply prime and tack coats when ambient temperature is above 60° F and when temperature has not been below 40° F for 12 hours immediately prior to applications. Do not apply when base is wet or contains an excess of moisture.

C. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at a minimum temperature of 250 deg F (121.1 deg C).
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

D. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches (25.4 to 38.1 mm) from strip to strip to ensure proper compaction of mix along longitudinal joints.
2. Complete a section of asphalt base course before placing asphalt surface course.

E. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.9 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (152.4 mm).
3. Offset transverse joints, in successive courses, a minimum of 24 inches (609.6 mm).
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method in accordance with AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

B. Longitudinal and transverse joints shall be made in a careful manner.

1. Well bonded and sealed joints are required. If necessary, in order to obtain this result, joints shall be painted with asphalt.
2. Both longitudinal and transverse joints in successive courses shall be staggered so as not to be one above the other.
3. Longitudinal joints shall be staggered a minimum of 6 inches and shall be arranged so that the longitudinal joint in the top course being constructed shall be at the location of the lane dividing the traffic lanes.

C. Joints between old and new pavements, or between successive days' work, shall be carefully made in such a manner as to ensure a thorough and continuous bond between old and new surfaces.

1. In the case of surface courses, the edge of the old and new surface course shall be cut back for its full depth so as to expose a fresh surface.
2. To obtain a well bonded joint, the surface shall be painted with hot asphalt, after which the hot surface mixture shall be placed in contact with it and raked to a proper depth and grade.
3. Before placing the mixture against them, all contact surfaces, of curbs, gutters, headers, manholes, etc., shall be painted with a thin uniform coating of hot asphalt cement or asphalt cement dissolved in Naptha.

3.10 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to an in-place density of 92.0 to 97.0 percent of the maximum density.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.11 ASPHALT CURBS

A. Construct hot-mix asphalt curbs over compacted pavement surfaces. Apply a light tack coat unless pavement surface is still tacky and free from dust. Spread hot-mix asphalt at a minimum temperature of 250 deg F (121.1 deg C).

1. Hot-Mix Asphalt: Same as pavement surface-course mix.

B. Place hot-mix asphalt to curb cross section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

3.12 ASPHALT TRAFFIC-CALMING DEVICES

A. Construct hot-mix asphalt speed bumps over compacted pavement surfaces. Apply a tack coat unless pavement surface is still tacky and free from dust. Spread hot-mix asphalt at a minimum temperature of 250 deg F (121.1 deg C).

1. Tack Coat Application: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.23 to 0.68 L/sq. m).
2. Hot-Mix Asphalt: Same as pavement surface-course mix.
3. Before installation, mill pavement that will be in contact with bottom of traffic-calming device. Mill to a depth of 1 inch (25.4 mm) from top of pavement to a clean, rough profile.

B. Place and compact hot-mix asphalt to cross section indicated, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

3.13 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch (12.7 mm).
2. Surface Course: Plus 1/4 inch (6.35 mm), no minus.

B. Pavement Surface Smoothness: Compact each course to produce surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch (6.35 mm).
2. Surface Course: 1/8 inch (3.18 mm).
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6.35 mm).

C. Asphalt Traffic-Calming Devices: Compact and form asphalt to the shapes indicated and within a tolerance of plus or minus 1/8 inch (3.18 mm) of height indicated above pavement surface.

3.14 SURFACE TREATMENTS

A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. (0.45 to 0.68 L/sq. m) to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.

B. Slurry Seals: Apply slurry coat in a uniform thickness in accordance with ASTM D3910 and allow to cure.

1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.15 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined in accordance with ASTM D3549/D3549M.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. Asphalt Traffic-Calming Devices: Finished height of traffic-calming devices above pavement will be measured for compliance with tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement in accordance with ASTM D979/D979M.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared in accordance with ASTM D2041/D2041M, and compacted in accordance with job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples in accordance with ASTM D1188 or ASTM D2726/D2726M.

a. One core sample will be taken for every 1000 sq. yd. (836 sq. m) or less of installed pavement, with no fewer than three cores taken.
b. Field density of in-place compacted pavement may also be determined by nuclear method in accordance with ASTM D2950/D2950M and coordinated with ASTM D1188 or ASTM D2726/D2726M.

F. Replace and compact hot-mix asphalt where core tests were taken.

G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.16 WASTE HANDLING

A. General: Handle asphalt-paving waste in accordance with approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

END OF SECTION

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

C. Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials, dated July, 2023 and as amended.

D. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition. Alternate methods and/or materials may be submitted to the Architect for consideration. Those judged to be equal to that specified will receive written approval.

1.2 SUMMARY

A. Section Includes Concrete Paving, including the following:

1. Driveways.
2. Roadways.
3. Parking lots.
4. Curbs and gutters.
5. Walks.
6. Dumpster Pads

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for general building applications of concrete.
2. Section 32 13 16 "Decorative Concrete Paving" for stamped concrete other than stamped detectable warnings.
3. Section 32 13 73 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
4. Section 32 17 13 "Parking Bumpers."
5. Section 32 17 23 "Pavement Markings."
6. Section 32 17 26 "Tactile Warning Surfacing" for detectable warning tiles, mats, and/or pavers.
7. Section 32 17 29 "Manufactured Traffic-Calming Devices."

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:
   a. Concrete mixture design.
   b. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Ready-mix concrete manufacturer.
   d. Concrete paving Subcontractor.
   e. Manufacturer's representative of stamped concrete paving system used for stamped detectable warnings.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.

C. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specifications Sections.

B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, joint systems, curing compounds, dry-shake finish materials, and others if requested by Architect.

C. Qualification Data: For qualified Installer of stamped detectable warnings, ready-mix concrete manufacturer, and testing agency.

D. Material certificates in lieu of material laboratory test reports when permitted by Architect. Material certificate shall be assigned by manufacturer and Contractor certifying that each material item complies with or exceed requirements. Provide certification from admixture manufacturers that chloride content complies with requirements

1. Material Certificates: For the following, from manufacturer:
   a. Cementitious materials.
   b. Steel reinforcement and reinforcement accessories.
   c. Fiber reinforcement.
   d. Admixtures.
   e. Curing compounds.
   f. Applied finish materials.
   g. Bonding agent or epoxy adhesive.
   h. Joint fillers.

E. Material Test Reports: For each of the following:

1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

F. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Concrete Standards: Comply with provisions of the following standards, except where more stringent requirements are indicated.

1. American Concrete Institute (ACI) 301, “Specifications for Structural Concrete for Buildings.”
2. ACI 318, “Building Code Requirements for Reinforced Concrete.”
3. Concrete Reinforcing Steel Institute (CRSI) “Manual of Standard Practice.”

B. Stamped Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.

C. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

D. Concrete Testing Service: The Contractor will engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.

1. The contractor shall provide the Testing Agency a minimum of 24 hours notice prior to the performance of such testing required.

E. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

F. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 96 inches (2438.4 mm) by 96 inches (2438.4 mm). Include full-size detectable warning.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

G. In the event of a discrepancy between the Project Specifications, Construction Documents, Baltimore County Standard Specifications and Details, or other guidelines set forth by the authorities having jurisdiction the more stringent will apply.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

1.9 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (26.7 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32.2 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from galvanized-steel wire into flat sheets.

B. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420); deformed.

C. Joint Dowel Bars: ASTM A615/A615M, Grade 60 (Grade 420) plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A767/A767M, Class I coating. Cut bars true to length with ends square and free of burrs.

D. Epoxy-Coated, Joint Dowel Bars: ASTM A775/A775M; with ASTM A615/A615M, Grade 60 (Grade 420) plain-steel bars.

E. Tie Bars: ASTM A615/A615M, Grade 60 (Grade 420); deformed.

F. Hook Bolts: ASTM A307, Grade A (ASTM F568M, Property Class 4.6), internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

H. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

I. Zinc Repair Material: ASTM A780/A780M.

2.4 CONCRETE MATERIALS

A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C150/C150M, white portland cement Type I.
   a. Use one brand of cement throughout project unless otherwise acceptable to Architect.
   b. Mix shall be in accordance with the Portland Association publication #IS174.02T “Concrete for Small Jobs”.
   c. All concrete shall be 3000 psi (MDSHA mix no.2), air-entrained (5% ± 1%) and the proportions by volume shall be in accordance with Table 32 13 00-1.
   d. Contractor shall furnish to the Owner delivery tickets for the concrete at the time of delivery.

TABLE 32 13 00-1
PROPORTIONS BY VOLUME

Maximum Size Coarse Aggregate	Cement	Sand	Aggregate	Water
3/8”	1	2 ¼”	1 ½”	½”
½”	1	2 ¼”	2	½”
¾”	1	2 ¼”	2 ½”	½”
1”	1	2 ¼”	2 ¾”	½”
1 ½”	1	2 ¼”	3	½”

B. Normal-Weight Aggregates: ASTM C33/C33M, Class 4S, uniformly graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1 ½ inches nominal.
2. Do not use fine or coarse aggregates that contain substances that cause spalling.
3. Local aggregates not complying with ASTM C33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Architect.

C. Air-Entraining Admixture: ASTM C260/C260M. Subject to compliance with requirements, provide one of the following:

1. Air-Tite or Amex 210; Cormix Construction Chemicals.
2. Air-Mix or Perma-Air; Euclid Chemical Co.
3. Darex AEA or Daravair; W.R. Grace & Co.
4. MB-VR or Micro-Air, Master Builders, Inc.
5. Sealtight AEA; W.R. Meadows, Inc.
6. Sika AER; Sika Corp.

D. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A. Subject to compliance with requirements, provide one of the following:
   a. Chemtard; ChemMasters Corp.
   b. Type A Services; Cormix Construction Chemicals.
   c. Eucon WR-75; Euclid Chemical Co.
   d. WRDA; W.R. Grace & Co.
   e. Pozzolith Normal or Polyheed; Master Builders, Inc.
   f. Metco W.R.; Metalcrete Industries.
   g. Plastocrete 161; Sika Corp.

2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

E. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Color: As selected by Architect from manufacturer's full range.

F. Water: Potable and complying with ASTM C94/C94M.

2.5 FIBER REINFORCEMENT

A. Synthetic Fiber, Monofilament Fibers: Monofilament polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches (12.7 to 38.1 mm) long.

B. Synthetic Fiber, Fibrillated Fibers: Fibrillated polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches (12.7 to 38.1 mm) long.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305.2 g/sq. m) dry or cotton mats.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Liquid Membrane-Forming Curing Compound: AASHTO M-148. Products: Subject to compliance with requirements, provide one of the following:

1. Clear Cure; Anti-Hydro Co., Inc.
2. Spartan-Cote; The Burke Co.
3. All Resin; Conspec Marketing & Mfg. Co.
4. Sealco 309; Cormix Construction Chemicals
5. Day-Chem Cure and Seal; Dayton Superior Corp.
6. Diamond Clear; Euclid Chemical Corp.
7. #64 Resin Cure-Clear; Lambert Corp.
8. L&M Cure R; L&M Construction Chemicals
9. Masterkure; Master Builders, Inc.
10. 3100 Series; W.R. Meadows, Inc.
11. Seal N Kure; Metalcare Industries
12. Kure-N-Seal; Sonneborn-Chemrex
13. Horn Clear Seal; Tamms/A.C. Horn

2.7 RELATED MATERIALS

A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber ASTM D1752, cork or self-expanding cork or ASTM D8139, semirigid, closed-cell polypropylene foam in preformed strips.

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

C. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene. Subject to compliance with requirements, provide one of the following:

1. Acrylic Bondcrete; the Burke Co.
2. Strongbond; Conspec Marketing and Mfg. Co.
3. Day-Chem Ad Bond (J-40); Dayton Superior Corp.
4. SBR Latex; Euclid Chemical Co.
5. Daraweld C; W.R. Grace & Co.
6. Everbond; L&M Construction Chemicals, Inc.
7. Acryl-Set; Master Builders, Inc.
8. Intralok; W.R Meadows, Inc.
9. Acrylpave; Metalcare Industries.
10. Sonocrete, Sonneborn-Chemrex
11. Stonlok LB2; Stonhard, Inc.
12. Strong Bond; Symons Corp.

D. Epoxy-Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2. Epoxy-Bonding Adhesive: Subject to compliance with requirements, provide one of the following:
   a. Burke Epoxy M.V.; the Burke Co.
   b. Spec-Bond 100; Conspec Marketing and Mfg. Co.
   c. Resi-Bond (J-58); Dayton Superior.
   d. Euco-Epoxy System #452 or #620; Euclid Chemical Co.
   e. Concresive Standard Liquid; Master Builders, Inc.
   f. Rezi-Weld 1000; W.R. Meadows, Inc.
   g. Metco Hi-Mod Epoxy; Metalcrete Industries.
   h. Sikadur 32 Hi-Mod; Sika Corp.
   i. R-6000 Series; Symons Corp.
   j. Epoxtite Binder 2390; Tamms/A.C. Horn, Inc

E. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of Portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Color: As selected by Architect from manufacturer's full range.

F. Rock Salt: Sodium chloride crystals, kiln dried, coarse gradation with 100 percent passing 3/8-inch (9.5 mm) sieve and 85 percent retained on a No. 8 (2.36 mm) sieve.

2.8 STAMPED DETECTABLE WARNING MATERIALS

A. Detectable Warning Stamp: Semirigid polyurethane mats with formed underside capable of imprinting detectable warning pattern on plastic concrete; perforated with a vent hole at each dome.

1. Size of Stamp: One piece, matching detectable warning area shown on Drawings.

B. Liquid Release Agent: Manufacturer's standard, clear, evaporating formulation designed to facilitate release of stamp mats.

2.9 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method. Do not use the Owner’s field quality-control testing agency as the independent testing agency.
2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

B. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content, 1-1/2 inch (38.1 mm)

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete as required for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

E. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd. (0.89 kg/cu. m).

F. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

G. Concrete Mixtures: Normal-weight concrete.

1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
2. Maximum W/C Ratio at Point of Placement: 0.42.
3. Slump Limit: 2 inches (50.8 mm) to 5 inches (127 mm).
4. Nominal Coarse Aggregate Size: No. 7 stone (2.83 mm).

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F (29.4 and 32.2 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32.2 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete batches of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete batches larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph (4.8 km/h).
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons (15.2 tonnes).
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch (12.7 mm) according to requirements in Section 31 20 00 "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

1. Top of Forms: Not more than ½ inch in 10 feet.
2. Vertical Face on Longitudinal Axis: Not more than ½ inch in 10 feet.

C. Clean forms after each use and coat with form release agent as required to ensure separation from concrete without damage.

3.4 INSTALLATION OF STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M.

G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2 inch (50.8 mm) overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints:

1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with key, unless indicated otherwise. Embed keys at least 1 ½ inches into concrete.
2. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
3. Provide tie bars at sides of paving strips where indicated.

4. Use bonding agent one existing concrete surfaces that will be joined with fresh concrete.
5. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
6. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches (38.1 mm) into concrete.
7. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 25 feet for sidewalks and 40 feet for curb and gutter, unless indicated otherwise.
2. Extend joint fillers full width and depth of joint, not less than ½ inch or more than 1 inch below finished surface where joint sealant is indicated. Place top of joint filler flush with finished concrete surface when no joint sealant is required.
3. Terminate joint filler not less than 1/2 inch (12.7 mm) or more than 1 inch (25.4 mm) below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a ¼ inch (6.35 mm) radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.

    a. Tolerance: Ensure that grooved joints are within 3 inches (76.2 mm) either way from centers of dowels.
2. Inserts: Form contraction joints by inserting premolded plastic, hardboard, or fiberboard strips into fresh concrete until top surface of strip is flush with paving surface. Radius each joint edge with a jointer tool. Carefully remove strips or caps of two-piece assemblies after concrete has hardened. Clean groove of loose debris
3. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8 inch (3.2 mm) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

    a. Tolerance: Ensure that sawed joints are within 3 inches (76.2 mm) either way from centers of dowels.
4. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a ¼ inch (6.35 mm) radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

F. Walks shall be constructed to match existing concrete.

1. Expansion joints between building and pavement shall be bituminous fiber type.

2. Expansion joints shall be installed between existing concrete pavement and new pavement.
3. Pavements shall be separated from curbs by a construction joint using felt roofing paper material.
4. “Vinylex Waterstop Cap Strip” control joint to be installed at a maximum of 25' and between existing walks and new concrete.
5. Saw cut control joints are not permitted.
6. Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one half of dowel length to prevent concrete bonding to one side of joint.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

1. When concrete placing is interrupted for more than ½ hour, place a construction joint.

G. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

H. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

I. Screed paving surface with a straightedge and strike off. Use bull floats or darbies to form a smooth surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces prior to beginning finishing operations.

J. Place concrete in two operations; strike off initial pour for entire width of placement and to the required finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.

1. Remove and replace portions of bottom layer of concrete that have been placed more than 15 minutes without being covered by top layer or use bonding agency if acceptable to Architect.

K. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

L. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutter to required cross section, lines, grade, finish and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete.

M. Slip-Form Paving: When automatic machine placement is used for paving, submit revised mix design and laboratory test results that meet or exceed requirements. Produce paving to required thickness, lines, grades, finish, and jointing as required for formed paving.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

N. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

O. Cold Weather Placement: Comply with provision of ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50° F and not more than 80° F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agent or chemical accelerators unless otherwise accepted in mix designs.

P. Hot Weather Placement: Place concrete complying with ACI 305R and as specified when hot weather conditions exist.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90° F. Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to concrete is Contractor's option.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperation immediately before embedding in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft sport, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch (1.6 to 3.2 mm) deep with a stiff-bristled broom, perpendicular to line of traffic.

C. Final Tooling: Tool edges of paving, gutter, curbs, and joints formed in fresh concrete with a jointing tool to the following radius. Repeat tooling of edges and joints after applying surface finishes. Eliminate tool marks on concrete surfaces.

1. Radius: 3/8 inch

3.8 INSTALLATION OF DETECTABLE WARNINGS

A. Blockouts: Form blockouts in concrete for installation of detectable paving units specified in Section 321726 "Tactile Warning Surfacing."

1. Tolerance for Opening Size: Plus 1/4 inch (6.35 mm), no minus.

B. Cast-in-Place Detectable Warning Tiles: Form blockouts in concrete for installation of tiles specified in Section 321726 "Tactile Warning Surfacing." Screed surface of concrete where tiles are to be installed to elevation, so that edges of installed tiles will be flush with surrounding concrete paving. Embed tiles in fresh concrete to comply with Section 321726 "Tactile Warning Surfacing" immediately after screeding concrete surface.

C. Stamped Detectable Warnings: Install stamped detectable warnings as part of a continuous concrete paving placement and according to stamp-mat manufacturer's written instructions.

1. Before using stamp mats, verify that the vent holes are unobstructed.
2. Apply liquid release agent to the concrete surface and the stamp mat.
3. Stamping: While initially finished concrete is plastic, accurately align and place stamp mats in sequence. Uniformly load, gently vibrate, and press mats into concrete to produce imprint pattern on concrete surface. Load and tamp mats directly perpendicular to the stamp-mat surface to prevent distortion in shape of domes. Press and tamp until mortar begins to come through all of the vent holes. Gently remove stamp mats.
4. Trimming: After 24 hours, cut off the tips of mortar formed by the vent holes.
5. Remove residual release agent according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with the recommendations of ACI 306R for cold weather protection and ACI 305R for hot weather protection during curing.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover, curing curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12 inch (304.8 mm) lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches (304.8 mm), and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.10 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 (ACI 117M) and as follows:

1. Elevation: 3/4 inch (19.05 mm).
2. Thickness: Plus 3/8 inch (9.5 mm), minus 1/4 inch (6.35 mm).
3. Surface: Gap below 10 feet (3 m) long; unleveled straightedge not to exceed 1/2 inch (12.7 mm).
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches (12.7 mm per 304.8 mm) of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch (25.4 mm).
6. Vertical Alignment of Dowels: 1/4 inch (6.35 mm).
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6.35 mm per 304.8 mm) of dowel.
8. Joint Spacing: 3 inches (76.2 mm).
9. Contraction Joint Depth: Plus 1/4 inch (6.35 mm), no minus.
10. Joint Width: Plus 1/8 inch (3.2 mm), no minus.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76.45 cu. m) or fraction thereof of each concrete mixture placed each day.
   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (26.7 deg C) and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M; one set of four standard cylinders for each compressive-strength test, unless directed otherwise. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.

6. Compressive-Strength Tests: ASTM C39/C39Mone set for each day's pour of each concrete class exceeding 5 cu. yd. But less than 25 cu. yd., plus one set for each additional 50 cu. yd. Test one specimen at 7 days, test two specimens at 28 days, and retain one specimen in reserve for later testing if required.

C. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.

D. When total quantity of a given class of concrete is less than 50 cu. yd., Architect may waive strength testing if adequate evidence of satisfactory strength is provided.

E. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operation and provide corrective procedures for protecting and curing the in-place concrete.

F. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.45 MPa).

G. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

H. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

I. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

J. Concrete paving will be considered defective if it does not pass tests and inspections.

K. Additional testing and inspecting: The testing agency will make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

L. Prepare test and inspection reports.

3.12 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with Portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 32 13 73 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

C. Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials, dated July, 2023 and as amended.

1.2 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Hot-applied joint sealants.
3. Cold-applied, fuel-resistant joint sealants.
4. Hot-applied, fuel-resistant joint sealants.
5. Joint-sealant backer materials.
6. Primers.

B. Related Requirements:

1. Section 07 92 00 "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in ½ inch (12.7 mm) wide joints formed between two 6 inch (152.4 mm) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Paving-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specifications Sections.

B. Product data for proprietary materials and items, including joint systems, and others if requested by Architect

C. Qualification Data: For firms and persons specified in the “Quality Assurance” Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Product Certificates: For each type of joint sealant and accessory.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

C. In the event of a discrepancy between the Project Specifications, Construction Documents, Baltimore County Standard Specifications and Details, or other guidelines set forth by the authorities having jurisdiction the more stringent will apply.

1.7 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.44 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.2 JOINT MATERIALS

A. Vinylex waterstop cap strip control joint manufactured by Vinylex or approved equal.

B. Preformed Joint Fillers:

1. The bituminous fiber type shall be in accordance with AASHTO M213 with the bituminous content determined by AASHTO T164.

2. The weathering test shall be deleted for either type of material

2.3 JOINT SEALANTS

A. Compatibility: Sealant fillers and all adjacent materials shall be compatible as demonstrated by sealant manufacturer testing.

B. Colors - Provide color of exposed joint sealants to comply with the following:

1. Match colors of concrete.

2.4 COLD-APPLIED JOINT SEALANTS

A. Cold Applied Joint Sealants shall be one part, polyurethane-base sealant for concrete pourable, chemically curing elastomeric formulation complying with the following requirements relative to formulation with ASTM C 920 for Type S, Grade NS, Class 25, and Uses indicated.

B. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D5893/D5893M, Type NS.

C. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D5893/D5893M, Type SL.

D. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade NS, Class 25, for Use T.

E. Single Component, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C920, Type S, Grade P, Class 25, for Use T.

F. Multicomponent, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade P, Class 25, for Use T.

2.5 HOT-APPLIED JOINT SEALANTS

A. Hot-Applied, Single-Component Joint Sealant: ASTM D6690, Type I.

B. Hot-Applied, Single-Component Joint Sealant: ASTM D6690, Type I or Type II.

C. Hot-Applied, Single-Component Joint Sealant: ASTM D6690, Type I, II, or III.

D. Hot-Applied, Single-Component Joint Sealant: ASTM D6690, Type IV.

2.6 COLD-APPLIED, FUEL-RESISTANT JOINT SEALANTS

A. Fuel-Resistant, Single-Component, Pourable, Modified-Urethane, Elastomeric Joint Sealant: ASTM C920, Type S, Grade P, Class 25, for Use T.

B. Fuel-Resistant, Multicomponent, Pourable, Modified-Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade P, Class 12-1/2 or 25, for Use T.

2.7 HOT-APPLIED, FUEL-RESISTANT JOINT SEALANTS

A. Hot-Applied, Fuel-Resistant, Single-Component Joint Sealants: ASTM D7116, Type I or Type II.

B. Hot-Applied, Fuel-Resistant, Single-Component Joint Sealants: ASTM D7116, Type III.

2.8 JOINT-SEALANT BACKER MATERIALS

A. Joint-Sealant Backer Materials: Non-staining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.

B. Backer Rods for Cold Applied Sealants: Performed, compressible, resilient, non-waxing, non-extruding strips of flexible, plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

1. Closed cell polyethylene foam, nonabsorbent to liquid water and gas, and non-outgassing in unruptured state.
2. Proprietary, reticulated, closed-cell polymeric foam, non-outgassing, with a density of 2.5 pcf and tensile strength of 35 psi per ASTM D 1623, and with water absorption less than 0.02 gram/cubic centimeter per ASTM C 1083.
3. Either material indicated above.

C. Bond Breaker Type: Polyethylene tape of other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesions would result in sealant failure. Provide self-adhesive tape where applicable.

D. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

E. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

F. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.9 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.

C. Install joint-sealant backings to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of joint-sealant backings.
2. Do not stretch, twist, puncture, or tear joint-sealant backings.
3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:

1. Place joint sealants so they fully contact joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and

replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

END OF SECTION

SECTION 32 17 13 - PARKING BUMPERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition. Alternate methods and/or materials may be submitted to the Architect for consideration. Those judged to be equal to that specified will receive written approval.

C. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

D. Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials, dated July, 2023 and as amended.

E. Manual on Uniform Traffic Control Devices for Streets and Highways, 2009 Edition and as amended.

1.2 SUMMARY

A. Section Includes:

1. Precast concrete wheel stops.
2. Resilient wheel stops.
3. Resilient-shell, concrete-filled wheel stops.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Precast concrete wheel stops.
2. Resilient wheel stops.
3. Resilient-shell, concrete-filled wheel stops

B. Samples for Initial Selection: For each type of exposed finish requiring color selection.

Samples for Verification: For wheel stops, 6 inches (152.4 mm) long, showing color and cross section; with mounting hardware.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS

A. Precast Concrete Wheel Stops: Precast, steel-reinforced (minimum of 2 - #5 bars required), air-entrained concrete; 4000-psi (27.6-MPa) minimum compressive strength; by 6 inches high by 8 inches wide by 72 inches (1829 mm) long. Provide chamfered corners, transverse drainage slots

on underside, and a minimum of two factory-formed or drilled vertical holes through wheel stop for anchoring to substrate.

1. Source Limitations: Obtain wheel stops from single source from single manufacturer.
2. Surface Appearance: Smooth, free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.
3. Surface Sealer: Manufacturer's standard salt-resistant, clear sealer, applied at precasting location.
4. Mounting Hardware: Galvanized-steel spike or dowel, ½ inch (12.7 mm) diameter, 14-inch (355.6 mm) minimum length.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation in accordance with manufacturer's written instructions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wheel stops in accordance with manufacturer's written instructions unless otherwise indicated.

B. Install wheel stops in bed of adhesive before anchoring to substrate.

C. Securely anchor wheel stops to substrate with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

END OF SECTION

SECTION 32 17 23 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

C. Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials, dated July, 2023 and as amended.

D. Manual on Uniform Traffic Control Devices for Streets and Highways, 2009 Edition and as amended.

1.2 SUMMARY

A. Section Includes:

1. Painted markings applied to asphalt paving.
2. Painted markings applied to concrete surfaces.

B. Related Requirements:

1. Section 01 77 00: Closeout Procedures.
2. Section 32 12 00: Flexible Paving.
3. Section 32 13 00: Rigid Paving.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to marking asphalt paving or concrete surfaces including, but not limited to, the following:
   a. Asphalt-paving or concrete-surface aging period before application of pavement markings.
   b. Review requirements for protecting pavement markings, including restriction of traffic during installation period.

1.4 ACTION SUBMITTALS

A. Product Data: Include technical data and tested physical and performance properties.

1. Pavement-marking paint, acrylic.
2. Pavement-marking paint, latex.
3. Glass beads.

B. Shop Drawings:

1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.

2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Qualification Data: For firms and persons specified in the “Quality Assurance” Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Material Test Reports: Indicate and interpret test results for compliance of materials with requirements indicated.

E. Material Certificates: Certificates signed by manufacturers certifying that each material complies with requirements.

F. Samples: For each exposed product and for each color and texture specified; on rigid backing, 8 inches (203.2 mm) square.

1.5 QUALITY ASSURANCE

A. In the event of a discrepancy between the Project Specifications, Construction Documents, Baltimore County Standard Specifications and Details, or other guidelines set forth by the authorities having jurisdiction the more stringent will apply.

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials, dated January, 2008 and as amended for pavement-marking work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer’s labels containing brand name and type of material, date of manufacture, and directions for storage,

B. Store pavement-marking materials in a clean, dry, protected location and within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F (4.4 deg C) for alkyd materials or 55 deg F (12.8 deg C) for water-based materials, and not exceeding 95 deg F (35 deg C).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain pavement-marking paints from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".

2.3 PAVEMENT MARKING PAINT

A. Pavement Marking Paint, Acrylic: Acrylic, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952F, Type II, with drying time of less than 45 minutes.
   1. Color: White, Yellow, and Blue.

B. Pavement Marking Paint, Latex: MPI #97, latex traffic-marking paint.
   1. Color: White, Yellow, and Blue.

C. Glass Beads: AASHTO M 247, Type 1 or FS TT-B-1325D, Type 1.
   1. Roundness: Minimum 75 percent true spheres by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement-marking substrate is dry and in suitable condition to begin pavement marking in accordance with manufacturer's written instructions.

B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

A. Pavement surfaces shall be dried free of oil, dirt, grease, and other contaminants prior to application of pavement markings surfaces not in conformance shall be cleaned by the Contractor to a width of 4 to 6 inches wider than the markings to be applied.

B. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

C. Allow asphalt paving or concrete surfaces to age for a minimum of 30 days before starting pavement marking.

D. Sweep and clean surface to eliminate loose material and dust.

E. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.38 mm).
   1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to asphalt paving or concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
   2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal. (0.72 kg/L).

F. Existing pavement markings that conflict with new or altered traffic pattern shall be completely removed by the Contractor. The method used by the Contractor for removal shall not damage the pavement surface and shall be approved by the Engineer. Any pavement damaged shall be repaired or replaced as determined by the Engineer at no additional cost to the Owner.

3.3 PROTECTING AND CLEANING

A. Protect pavement markings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 32 17 26 - TACTILE WARNING SURFACING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. ADA Standards for Accessible Design, dated 2010, and as amended.

C. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

D. Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials, dated July, 2023 and as amended.

E. Throughout the specifications, types of materials may be specified by manufacturer’s name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition. Alternate methods and/or materials may be submitted to the Architect for consideration. Those judged to be equal to that specified will receive written approval.

1.2 SUMMARY

A. Section Includes:

1. Cast-in-place detectable warning tiles.
2. Surface-applied detectable warning tiles.
3. Detectable warning mats.
4. Cast-in-place detectable warning metal tiles.
5. Surface-applied detectable warning metal tiles.
6. Detectable warning unit pavers.

B. Related Requirements:

1. Section 32 13 13 "Concrete Paving" for concrete walkways serving as substrates for tactile warning surfacing.
2. Section 32 14 00 "Unit Paving" for unit paving installations incorporating detectable warning unit pavers specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of exposed finish requiring color selection.

C. Samples for Verification: For each type of tactile warning surface, in manufacturer's standard sizes unless otherwise indicated, showing edge condition, truncated-dome pattern, texture, color, and cross section; with fasteners and anchors.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1.6 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Adhesive Application:

1. Apply adhesive only when ambient temperature is above 50 deg F (10 deg C) and when temperature has not been below 35 deg F (1.7 deg C) for 12 hours immediately before application. Do not apply when substrate is wet or contains excess moisture.

C. Weather Limitations for Mortar and Grout:

1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F (37.8 deg C) and higher.

a. When ambient temperature exceeds 100 deg F (37.8 deg C), or when wind velocity exceeds 8 mph (12.9 km/h) and ambient temperature exceeds 90 deg F (32.2 deg C), set unit pavers within 1 minute of spreading setting-bed mortar.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering and wear.
b. Separation or delamination of materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for tactile warning surfaces.

1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.

B. Source Limitations: Obtain each type of tactile warning surfacing, joint material, setting material, anchor, and fastener from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 DETECTABLE WARNING TILES

A. Cast-in-Place Detectable Warning Tiles: Accessible truncated-dome detectable warning tiles with replaceable surface configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.

1. Material: Cast-fiber-reinforced polymer concrete tile.
2. Color: Safety yellow or Red brick.
3. Shapes and Sizes:
    a. Rectangular panel, Length : Full width of flush curb / ADA sidewalk compliant ramp by 2 feet minimum depth from face of flush curb / edge of traveled way.
4. Dome Spacing and Configuration: 2.35-inch (59.7-mm) spacing, in square pattern.
5. Mounting:
    a. Replaceable detectable warning tile wet-set into freshly poured concrete and surface-fastened to permanently embedded anchors.

B. Surface-Applied Detectable Warning Tiles: Accessible truncated-dome detectable warning concrete tiles configured for surface application on existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of tile, and beveled outside edges.

1. Material: Cast-fiber-reinforced polymer concrete tile.
2. Color: Safety yellow or Red brick.
3. Shapes and Sizes:
    a. Rectangular panel, Length: Full width of flush curb / ADA sidewalk compliant ramp by 2 feet minimum depth from face of flush curb / edge of traveled way.
4. Dome Spacing and Configuration: 2.35-inch (59.7-mm) spacing, in square pattern.
5. Mounting: Adhered and fastened to existing concrete walkway.

C. Surface-Applied Detectable Warning Metal Tiles: Accessible truncated-dome detectable warning metal tiles or plates configured for fastening to surface of existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of tile, and beveled outside edges.

1. Material: Stainless-Steel Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

2. Finish and Color:

   a. Manufacturer's standard powder coat, safety yellow or red brick.
   b. Mill finish.

3. Shapes and Sizes:

   a. Rectangular panel, Rectangular panel, Length: Full width of flush curb / ADA sidewalk compliant ramp by 2 feet minimum depth from face of flush curb / edge of traveled way.

4. Dome Spacing and Configuration: 2.35-inch (59.7-mm) spacing, in square pattern.
5. Mounting:

   a. Replaceable surface-applied detectable warning tile fastened with permanently installed anchors to existing concrete walkway.
   b. Permanently fixed detectable warning tile adhered and fastened to existing concrete walkway.

2.3 DETECTABLE WARNING MATS

A. Surface-Applied Detectable Warning Mats: Accessible truncated-dome detectable warning resilient mats, UV resistant, manufactured for adhering to existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of mat, and beveled outside edges.

1. Material: Modified rubber compound, UV resistant.
2. Color: As selected by Architect from manufacturer's full range.
3. Shapes and Sizes:

   a. Rectangular panel, Rectangular panel, Length: Full width of flush curb / ADA sidewalk compliant ramp by 2 feet minimum depth from face of flush curb / edge of traveled way.

4. Dome Spacing and Configuration: 2.35-inch (59.7-mm) spacing, in square pattern.
5. Mounting: Adhered to pavement surface with adhesive and fastened with fasteners.

2.4 DETECTABLE WARNING UNIT PAVERS

A. Detectable Warning Concrete Unit Pavers: Solid paving units, made from normal-weight concrete with a compressive strength of not less than 5000 psi (34.5 MPa), water absorption of not more than 5 percent according to ASTM C 140, and no breakage and not more than 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67, with accessible detectable warning truncated domes on exposed surface of units.

1. Shapes and Sizes:

   a. Thickness: 2-1/2 inches (63.5 mm) at field of tile.
   b. Face Size: Nominal 12 by 12 inches (304.8 by 304.8 mm).

2. Dome Spacing and Configuration: 2.35-inch (59.7-mm) spacing, in square pattern.
3. Color: As selected by Architect from manufacturer's full range.

B. Setting Bed: Comply with requirements in Section 321400 "Unit Paving."

C. Mortar Setting Bed:

1. Portland Cement: ASTM C 150/C 150M, Type I or Type II.
2. Sand: ASTM C 33/C 33M.

3. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed Portland cement and aggregate mortar bed, and not containing a retarder.
4. Thinset Mortar: Latex-modified Portland cement mortar complying with ANSI A118.4.
5. Water: Potable.

2.5 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of tactile warning surfaces, noncorrosive and compatible with each material joined, and complying with the following:

1. Furnish Type 304 stainless-steel fasteners for exterior use.
2. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.

B. Adhesive: As recommended by manufacturer for adhering tactile warning surfacing unit to pavement.

C. Sealant: As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TACTILE WARNING SURFACING

A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.

B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.

3.3 INSTALLATION OF DETECTABLE WARNING TILES

A. Removable Cast-in-Place Detectable Warning Tiles:

1. Concrete Paving Installation: Comply with installation requirements in Section 321313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of removable tile.
2. Set each detectable warning tile accurately and firmly in place with embedding anchors and fasteners attached, and firmly seat tile back in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.

3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch (3.2 mm) from flush.
4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
5. Clean tiles using methods recommended in writing by manufacturer.

B. Surface-Applied Detectable Warning Tiles:

1. Lay out detectable warning tiles as indicated and mark concrete pavement.
2. Prepare existing paving surface by grinding and cleaning as recommended by manufacturer.

    a. Cut perimeter kerf in existing concrete pavement to receive metal tile flange.

3. Apply adhesive to back of tiles in amounts and pattern recommended by manufacturer, and set tiles in place. Firmly seat tiles in adhesive bed, eliminating air pockets and establishing full adhesion to pavement. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
4. Install anchor devices through face of tiles and into pavement using anchors located as recommended by manufacturer. Set heads of anchors flush with top surface of mat.
5. Mask perimeter of tiles and adjacent concrete, and apply sealant in continuous bead around perimeter of tile installation.
6. Remove masking, adhesive, excess sealant, and soil from exposed surfaces of detectable warning tiles and surrounding concrete pavement using cleaning agents recommended in writing by manufacturer.
7. Protect installed tiles from traffic until adhesive has set.

3.4 INSTALLATION OF DETECTABLE WARNING MATS

A. Lay out detectable warning mats as indicated and mark concrete pavement at edges of mats.

B. Prepare existing paving surface by grinding and cleaning as recommended by manufacturer.

C. Apply adhesive to back of mat in amounts and pattern recommended by manufacturer, and set mat in place. Firmly seat mat in adhesive bed, eliminating air pockets and establishing full adhesion to pavement. If necessary, temporarily apply weight to mat to ensure full contact with adhesive.

D. Install anchor devices through face of mat and into pavement using anchors located as recommended by manufacturer. Set heads of anchors flush with mat surface.

E. Mask mat perimeter and adjacent concrete, and apply sealant in continuous bead around perimeter of mat.

F. Remove masking, adhesive, excess sealant, and soil from exposed surfaces of detectable warning mat and surrounding concrete pavement using cleaning agents recommended in writing by manufacturer.

G. Protect installed mat from traffic until adhesive has set.

3.5 INSTALLATION OF DETECTABLE WARNING UNIT PAVERS

A. Unit Paver Installation, General:

1. Setting-Bed and Unit Paver Installation: Comply with installation requirements in Section 321400 "Unit Paving."
2. Mix unit pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
3. Cut unit pavers with motor-driven masonry saw equipment to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible.
4. Tolerances: Do not exceed 1/4 inch in 10 feet (6.35 mm in 3 m) from level, or indicated slope, for finished surface of paving.

B. Mortar Setting-Bed Applications:

1. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
2. Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing mortar bed. Limit area of bond coat to avoid its drying out before placing setting bed. Do not exceed 1/16 inch (1.6 mm) thickness for bond coat.
3. Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.
4. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.
5. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16 inch (1.6 mm) thick bond coat to mortar bed or to back of each paver with a flat trowel.
6. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.
7. Spaced Joint Widths: Provide 3/8 inch (9.5 mm) nominal joint width with variations not exceeding plus or minus 1/16 inch (1.6 mm).
8. Grouted Joints: Grout paver joints complying with ANSI A108.10. Grout joints as soon as possible after initial set of setting bed.

    a. Force grout into joints, taking care not to smear grout on adjoining surfaces.
    b. Tool exposed joints slightly concave when thumbprint hard.
    c. Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.

9. Remove excess grout from exposed paver surfaces; wash and scrub clean.
10. Protect installation from traffic until grout has set.

3.6 QUALITY ASSURANCE

A. In the event of a discrepancy between the Project Specifications, Construction Documents, Baltimore County Standard Specifications and Details, or other guidelines set forth by the authorities having jurisdiction the more stringent will apply.

3.7 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

3.8 CLEANING AND PROTECTION

A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.

B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION

SECTION 32 31 00 – VEHICULAR GATE OPERATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electric gate operators as basis of design.
   1. DoorKing Model 6300.
   2. ADD ALT #4 Wallace Perimeter PDXT Speedgate Operator.

B. Gate operators.

C. Sensors and controls.

D. Access Controls

1.2 RELATED SECTIONS

A. Section 32 31 19 – Ornamental Fence Systems: Adjoining fences and gates.

B. Section 03 30 00 – Cast-in-Place Concrete: Concrete mounting pads.

C. Division 26 – Requirements for electrical connections.

1.3 REFERENCES

A. Underwriters Laboratories (UL): UL 325 – Standard for Safety for Door, Drapery, Gate, Louver, and Window Operators and Systems.

B. Canadian Standards Association (CSA): CSA C22.2 No. 247.

C. Underwriters Laboratories (UL): UL 991 – Standard for Tests for Safety Related Controls Employing Solid-State Devices.

D. American Society Testing Materials (ASTM): ASTM F2200 – Standard Specification for Automated Vehicular Gate Construction.

E. National Electrical Manufacturers Association (NEMA): NEMA ICS 6 – Industrial Control Systems: Enclosures.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Product Data: Manufacturers data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements.
   3. Installation methods.

C. Shop Drawings: Submit shop drawings showing fence/gate layout, post locations, electrical conduit and junction boxes, gate operator units, electric eyes, profiles, and product components, including anchorage, edge connections, and accessories.
   1. Operation, installation, and maintenance manuals including wire diagrams.

2. Risers, layouts, and special wiring diagrams showing any changes to standard drawings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials and products in strict compliance with manufacturer's instructions and industry standards.

B. Store products indoors in manufacturer's original containers and packaging with labels clearly identifying product name and manufacturer. Protect from damage.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Substantial transformation and final assembly shall occur in the United States of America per Section 1605 of the ARRA-09.

B. Installer Qualifications: Installation performed by factory authorized dealer contractor specifically trained in gate operator systems of the type found within this section.

1. Provide documentation of maintenance and repair service availability for emergency conditions.
2. Provide quarterly maintenance for one year following Substantial Completion of the Project.

1.7 WARRANTY

A. Manufacturers standard five (5) year warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: DoorKing, Inc.; 120 S. Glasgow Ave; Inglewood, CA 90301; Toll-Free Tel: 800-826-7493; Tel: 310-645-0023; Fax: 310-641-1586; Email: ghendrix@doorking.com; Web: doorking.com.

1. Basis of Design: DoorKing Model 6300 Swing Gate Operator

B. ADD ALT #4: Wallace Perimeter PDXT Speedgate Operator.

C. Requests for substitutions will be considered in accordance with the provisions of Section 01 60 00 – Product Requirements.

2.1 SWINGING GATE OPERATORS

A. Microprocessor based solid-state control board interacting with card readers, RF transmitters, access control systems, ticket machines, other activating devices as required, external devices (photo-eyes, contact edges) for entrapment protection. Control board shall include built-in close timer (1-25 seconds), dual-gate overlap feature, built-in ports for two (2) plug-in loop detectors, programming switches to set various operating modes, inherent magnetic pulse obstruction sensing reverse system. System shall employ Fail-Safe operation upon primary (AC) power outage.

1. Compliance: Compliant to UL 325, UL 991 and CSA C22.2 No. 247 and listed by Intertek Testing Laboratories NA, Inc. (ETL), a Nationally Recognized Testing Laboratory.

a. This model is intended for use in Class I, II, III and IV vehicular swing gate applications.

2. Warranty: Five (5) year manufacturer's standard warranty.
3. Maximum Gate length (each) :
   a. 12-feet with 1/2 HP motor.
4. Maximum Gate Weight:
   a. 700 Lbs. with 1/2 HP motor.
5. Operator speed: 90-degrees in approximately 17 seconds.
6. Frame: G90 hot dipped 10 gage (.134-inch) galvanized steel.
7. Enclosure: Polypropylene .125-inch texture gray.
8. Configuration: Left or right hand mount.
9. Mounting:
   a. Pad Mount.
10. Electrical Power Requirements: 208 VAC
    a. 208 VAC requires DoorKing High Voltage Kit as basis of design, which must be factory installed.
11. Motor: Continuous Duty Motor.
    a. 1/2 HP
12. Fail-Safe Operation: Upon loss of primary (AC) power, system shall revert to a fail-safe mode allowing the gate to be pushed open without the use of special knowledge, keys or other releasing mechanisms.
13. Primary Reduction: Adjustable clutch, single cog belt drive train to worm reduction gear.
14. Magnetic Limit Switches: Automatic setting with no mechanical switches to set, wear out or break.
15. Operating Switches: Built-in power (on-off), reset and operating switches.
16. Convenience Outlets: Two (2) 115 VAC for accessory transformers.
17. Vehicle Sensing: As a substitute for embedded Vehicle Sensing Loops, this project will implement the BEA LZR H100 Laser Vehicle Sensors as manufactured by BEA. The field size and coverage of each sensor field is to be set up with the dimensions as shown in the plans.

    Each BEA LZR H100 Laser Vehicle Sensor will be mounted on a Torxun LZR Vault, as manufactured by Torxun, Inc.
    a. Gate will utilize (3) H100 sensor; (1) for the exterior Open/Exit/Obstruction detection; (1) for the Shadow detection; (1) for the interior Open/Exit/Obstruction detection.
18. Entrapment Protection as required by UL325 & ASTM F2200 Standards.
    a. Photo-electric eye (non-contact sensor).
    b. Sensing edge (contact sensor).
19. Accessories: Provide the optional accessories listed below.
    a. Thermostatically controlled heater kit.
    b. Electric reversing edge – reverses direction of gate on contact with an obstruction; as required by UL325 & ASTM F2200 Standards.
    c. Photo-electric beams – reverses direction of gate if the light beam is obstructed; as required by UL325 & ASTM F2200 Standards.
    d. High Voltage Kit; p/n 2600-266 as manufactured by Doorking, Inc. basis of design.
    e. Post Mount Kit; p/n 2600-263 as manufactured by DoorKing, Inc. basis of design.

2.2 ACCESS CONTROL DEVICES

A. Submit options for final selection.

B. REQUIRED DEVICES

1. All Gates

a. Fire Department Emergency Access, as required by Local Authority Having Jurisdiction.

b. Emergency Access, as required by Local Authority Having Jurisdiction.

c. Submit options for access control of gates for final selection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. It is preferred but not required, that this product be installed by a qualified technician who is certified by either the Accreditation and Certification Institute (ACI) or the Institute of Door Dealer Education and Accreditation (IDEA).

B. All gate operator units shall be mounted, firmly secured, plumb and level, as required.

C. Wiring shall be uniform and in accordance with national electric codes and manufacturer’s instructions.

D. All splices shall be in easily accessible junction boxes or on terminal boards.

E. All cable runs in all junction boxes shall be tagged and identified.

F. Coordinate all work with other effected trades and contractors.

3.2 SYSTEM INITIALIZING AND PROGRAMMING

A. System shall be turned on and adjustment made to meet requirements of specifications and on-site conditions.

B. System shall function as specified.

3.3 SYSTEM TEST PROCEDURES

A. System shall be completely tested to assure that all components and accessories are hooked-up and in working order.

B. System shall be pre-tested by contractor and certified to function in accordance with plans and specifications.

C. System shall be tested in presence of owner's representative.

3.4 OWNER INSTRUCTIONS

A. Installation contractor shall conduct up to (1) hour of instruction in use and operation of the system to designated owner representatives, within (30) days of acceptance.

B. Installation contractor shall conduct up to (1) hour of technical training, in troubleshooting and service of the system, to designated owner representatives within (90) days of system acceptance.

3.5 MANUALS AND DRAWINGS

A. Contractor shall provide owner with (2) copies of standard factory prepared operation, installation, and maintenance manuals. Manuals shall include typical wiring diagrams.

B. Contractor shall provide owner with (2) copies of any risers, layouts, and special wiring diagrams showing any changes to standard drawings, if required on project.

3.6 MAINTENANCE

A. The manufacturer recommends periodic maintenance at one (1), three (3) and 12-month intervals as described in the installation and maintenance manual.

B. External reversing devices should be checked at least once a month.

END OF SECTION 32 31 00

SECTION 32 31 19 - DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Perimeter Security Fence (F2, G1, G2 & G2 ADD ALT #4)

B. Related Requirements:

   1. Section 033000 "Cast-in-Place Concrete" for concrete post fill.

1.3 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each fence material and for each color specified.

   1. Provide Samples 12 inches in length for linear materials.

   2. Shop drawings for all fence and gates. Drawings should be signed and sealed by contractor’s structural engineer.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

   1. Include 10-foot length of fence complying with requirements.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

2.2 DECORATIVE STEEL FENCES WITH SWING GATES

A. Perimeter Security Fence (F2, G1, G2 & G2 ADD ALT #4)

Manufacturer: Long Fence

Type: Barbed Wire Security Fence w/ vinyl coating

Color: Black

Anti-scale, 120” height, posts at 10’-0 O.C. spacing max.

2-3/8” Dia. Intermediate posts; 2-7/8” Dia. Terminal posts (PC-20) (or per manufacturer’s standards).

Standard 9-gauge chain link; 40 weight posts (or per manufacturer's standards).

45° arms attached to fence for barbed wire, angled out.

Vehicular and pedestrian swing gates to match fence.

B. G2 - ADD ALT #4

Manufacturer: Wallace Perimeter Security.

Model: PDXT Speedgate w/ anti-climb top guard. 20’ clear min., 8’ ht.

Color: Powder coated black.

Infill: Standard.

Attachment: Per manufacturer.

C. PRODUCTS

Manufacturer: FenceScreen https://www.fencescreen.com

Type: Fenpro Blade Slat, Bottom Locking.

Model: 4000 Series.

Color: Obsidian Black.

Size: 8 ft.

2.3 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for strength and compatibility in fabricated items.

B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 033000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch maximum aggregate size or dry, packaged, normal-weight concrete mix complying with ASTM C 387/C 387M mixed with potable water according to manufacturer's written instructions.

C. Non-shrink Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M and specifically recommended by manufacturer for exterior applications.

2.4 GROUNDING MATERIALS

A. Grounding Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.

1. Material above Finished Grade: Copper.
2. Material on or below Finished Grade: Copper.
3. Bonding Jumpers: Braided copper tape, 1 inch wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.

B. Grounding Connectors and Grounding Rods: Comply with UL 467.

1. Connectors for Below-Grade Use: Exothermic-welded type.
2. Grounding Rods: Copper-clad steel.

a. Size: 5/8 by 96 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.

B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

1. Construction layout and field engineering are specified in Section 017300 "Execution."

3.3 DECORATIVE FENCE INSTALLATION

A. Install fences according to manufacturer's written instructions.

B. Install fences by setting posts as indicated and fastening rails and infill panels to posts. Peen threads of bolts after assembly to prevent removal.

C. Post Excavation: Drill or hand-excavate holes for posts in firm, undisturbed soil. Excavate holes to a diameter of not less than 4 times post size and a depth of not less than 24 inches plus 3 inches for each foot or fraction of a foot that fence height exceeds 4 feet.

D. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
2. Concrete Fill: Place concrete around posts and sleeves and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

    a. Exposed Concrete: Extend 1 inch above grade. Finish and slope top surface to drain water away from post.
    b. Concealed Concrete: Top 2 inch below grade to allow covering with surface material. Slope top surface of concrete to drain water away from post.

3. Posts Set in Concrete: Extend post to within 6 inches of specified excavation depth, but not closer than 3 inches to bottom of concrete.
4. Posts Set into Concrete in Sleeves: Use galvanized-steel pipe sleeves with inside diameter at least 3/4 inch larger than outside diagonal dimension of post, preset and anchored into concrete for installing posts.

a. Extend posts at least 5 inches into sleeve.
b. After posts have been inserted into sleeves, fill annular space between post and sleeve with non-shrink grout, mixed and placed to comply with grout manufacturer's written instructions; shape and smooth to shed water. Finish and slope top surface of grout to drain water away from post.

5. Posts Set into Voids in Concrete: Form or core drill holes not less than 3/4 inch larger than outside diagonal dimension of post.

a. Extend posts at least 5 inches into concrete.
b. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink grout, mixed and placed to comply with grout manufacturer's written instructions. Finish and slope top surface of grout to drain water away from post.

6. Space posts uniformly at 5 feet o.c.

3.4 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.5 GROUNDING AND BONDING

A. Fence Grounding: Install at maximum intervals of 1500 feet except as follows:

1. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.

B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.

C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.

D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.

E. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

F. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.
2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
3. Report: Prepare test reports of grounding resistance at each test location certified by a testing agency. Include observations of weather and other phenomena that may affect test results.

3.7 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

END OF SECTION 32 31 19

SECTION 32 32 19 - CONCRETE RETAINING WALLS AND FENCING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work shall consist of designing, permitting, furnishing and construction of a precast modular block retaining wall system in accordance with these specifications and in reasonably close conformity with the lines, grades, design and dimensions shown on the plans. Alternate wall systems will be considered.

B. Work includes preparing foundation soil, furnishing and installing leveling pad, unit facing system, unit drainage fill, and reinforced backfill to the lines and grades shown on the construction drawings.

1.2 REFERENCE SECTIONS

A. Section 01 33 00 – Submittals Procedures
B. Section 31 00 00 – Earthwork

1.3 REFERENCE DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

C. Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials, dated July, 2023 and as amended.

D. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition. Alternate methods and/or materials may be submitted to the Architect for consideration. Those judged to be equal to that specified will be reviewed for approval.

E. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO M 252 Corrugated Polyethylene Drainage Pipe
2. AASTHO M 288 Geotextile Specification for Highway Applications

F. American Society for Testing and Materials (ASTM)

1. ASTM C33 Standard Specification for Concrete Aggregates
2. ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
3. ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregate
4. ASTM C1776 Standard Specification for Wet-Cast Precast Modular Retaining Wall Units
5. ASTM D442 Particle Size Analysis of Soils
6. ASTM D698 Laboratory Compaction Characteristics of Soil – Standard Effort
7. ASTM D4318 Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

8. ASTM D4595 Standard Test Method for Tensile Properties of Geotextiles by Wide-Width Strip Method
9. ASTM 4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
10. ASTM D5262 Standard Test Method for Evaluating the Unconfined Tension Creep Behavior of Geosynthetics
11. ASTM D6637 Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Method
12. ASTM D6638 Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units
13. ASTM D6916 Standard Test Method for Determining the Shear Strength Between Segmental Concrete Units

1.4 DEFINITIONS

A. Unit Drainage Fill – drainage aggregate that is placed within and immediately behind the precast modular concrete units.

B. Reinforced Backfill – compacted soil that is placed within the reinforced soil volume as outlined on the plans.

C. Retained Soil – the soil mass behind the reinforced backfill.

D. Leveling Pad – crushed stone, sand and gravel or unreinforced concrete material placed to provide a level surface for placement of the precast modular concrete units.

1.5 SUBMITTALS AND CERTIFICATION

A. Contractor shall submit a Manufacturer’s certification, prior to the start of work, that the retaining wall system components meet the requirements of this specification and the structural design.

B. Contractor shall submit construction drawings and design calculations for the retaining wall system prepared and stamped by a Professional Engineer registered in the State of Maryland. The submittal shall indicate the layout, height, block sizes, and construction details of the system.

C. Contractor shall submit product information, for approval, for graffiti-proof clear coating to be applied to select parts of the precast modular block units. Product information shall include, but not be limited to chemical composition and conformance to all applicable Federal, State and Local environmental regulations.

D. If stain shall be applied to the wall system, a sample shall be stained on site for review and approval by the Architect and/or Owner. Contractor shall consult Architect and Owner, prior to applying stain, for application location.

E. Submit grain size test results for aggregates to be used for the wall base and for unit fill.

F. Submit test results on borrow material to be used for common backfill and for select backfill (if used) including Proctor and grain size or Atterberg limits results.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall check the materials upon delivery to assure that proper materials have been received.

B. Contractor shall protect the materials from damage. Damaged material shall not be incorporated into the wall or the reinforced soil embankments.

C. Contractor shall prevent excessive mud, concrete, adhesives and other substances that may adhere from coming in contact with the materials.

D. Exposed faces of precast modular block units shall be reasonably free of chips, cracks, or stains when viewed from a distance of 10 feet (3 m).

PART 2 - PRODUCTS

2.1 WALL UNITS

A. Wall units shall conform to ASTM C1776/C1776M-17.

B. Dimension tolerances for precast modular blocks shall be +/- 1/8 inch (+/-3 mm) for height, +/- 1/8 inch (+/-3 mm) for length (along face), and +1/2 to -1/4 inch (+13 mm to -6 mm) for width (face to tail). At least 70% of the wall system units shall consist of a minimum unit size of 24 sq. ft. on the face of the unit.

C. Concrete for precast modular blocks shall have a minimum 28-day compressive strength of 4,000 psi (28 MPa) and be cast by an NPCA approved shop. Entrained air content shall be between 5 and 7%.

D. Internal unit reinforcement or unreinforced units shall be provided according to the manufacturer's or professional engineer's engineering guidance. Reinforced units shall be marked with the type of reinforcement.

E. The face pattern shall be selected from the manufacturer's standard molds. The color of the units shall be natural gray. A concrete stain may be field applied to color the units if specified by the Engineer or Owner.

2.2 WALL BASE

A. The wall base shall consist of dense graded crushed aggregate. A minimum of 75% of coarse material shall have 2 or more fractured faces. Wall base material shall meet the following gradation:

US Standard Sieve Size	Metric Standard Sieve Size	Percent Passing
1-1/2”	37.5 mm	80-100
3/4"	19.0 mm	50-90
#4	4.75 mm	0-40
#200	75 µm	0-10

B. The contractor may substitute concrete with a minimum 28-day compressive strength of 3,000 psi (21 Mpa) for the granular base material. Concrete may be placed full thickness or as a topping over a compacted granular the base. If used as a topping, the concrete shall have a minimum thickness of 3 inches (75 mm).

2.3 UNIT FILL

A. Unit fill shall consist of a screened crushed aggregate. A minimum of 75% of coarse material shall have 2 or more fractured faces. Unit fill material shall meet the following gradation:

US Standard Sieve Size	Metric Standard Sieve Size	Percent Passing
1-1/2”	37.5 mm	100
3/4"	19.0 mm	50-90
#4	4.75 mm	0-10
#8	2.36 mm	0-5

Unit fill should generally be a screened aggregate with a maximum size around ¾” to 1½” (19 to 38 mm). Recycled concrete aggregate may also be used subject to acceptable gradation, and cracked gravel may be acceptable in some cases. A well graded aggregate is not desirable for unit fill. Rather, the material should be coarse graded so that it will spill into and fill the voids within the blocks and will be free draining. The critical sieve sizes are the #4 (4.75 mm) sieve to limit loss through the block joints and a limit on the fines (less than 2% minus #200 or 75 µm sieve, but a larger sieve may be used as a proxy for fines) to maintain a free draining condition. The design should account for the properties of the material specified if the gradation varies significantly from above.

2.4 BACKFILL

A. If a select granular reinforced zone is indicated, it shall consist of fill sand or other clean aggregate meeting the following gradation:

US Standard Sieve Size	Metric Standard Sieve Size	Percent Passing
3/4"	19.0 mm	100
#200	75 µm	0-5

B. All other backfill behind and in front of the wall shall consist of suitable on-site soil or imported borrow and shall be approved by the Geotechnical Engineer. Backfill shall generally consist of sands, silts, or lean clays with a liquid limit less than 45 and a plasticity index less than 20. Fat clay soils, cobbles, and large rock should generally be avoided unless approved by the Geotechnical Engineer based on local practices. Frozen soils, excessively wet or dry soils, debris, and deleterious materials should not be used.

2.5 DRAIN TILE

A. The internal drainage plane from the top to the bottom of the wall must be completely integral to the footprint of the wall itself (not placed behind the wall).

2.6 GEOTEXTILE FABRIC

A. Provide a geotextile filter for separation from backfill at the tails of the blocks. The geotextile shall be a needle punched non-woven fabric with a minimum grab tensile strength of 120 pounds (534 N). The geotextile may cover the entire back face of the blocks or may be cut in strips to cover the gaps between tail units with a minimum of 6 inches (150 mm) of overlap over the concrete tail on both sides.

2.7 WALL ORIENTATION

A. Wall system must be oriented in a completely vertical orientation from bottom toe of wall to top, or “0” set back/batter.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavate as required for installation of the retaining wall system. Excavate to the base level for a sufficient distance behind the face to permit installation of the base.

B. Slope or shore excavation as necessary for safety and for conformance with applicable OSHA requirements.

3.2 WALL BASE

A. Foundation soils shall be excavated to the dimensions shown on the plans. Foundation soil shall be observed by the Geotechnical Engineer to confirm that the bearing soils are similar to the design conditions or assumptions.

B. Construct the wall base to the lines and grades shown on the plans. Place and consolidate concrete, strike, and finish plane and level. Overexcavated areas shall be filled with additional concrete or granular base material. Compact granular base material to provide a hard and level surface to support the wall units. Base material shall be compacted to a minimum of 95 percent maximum dry density (ASTM D698, Standard Proctor). Final base elevation shall be within 0.1 feet (30 mm) of plan elevation.

C. Prepare and smooth the granular material to ensure complete contact of the first course with the base. The base may be dressed with fine aggregate to aid leveling.

3.3 UNIT INSTALLATION

A. Place the first course of units directly on the wall base. Check units for level and alignment. Units shall be within 1/8 inch (3 mm) of level from end to end and from front to back. Adjacent units should be in contact. If possible, begin placing units at the lowest section of the wall.

B. Fill all voids between and within the blocks with granular unit fill. Additional unit fill is not required behind the units, but may be placed for the convenience of the contractor.

C. Place backfill behind the units in maximum loose lifts of 8 inches (200 mm) and compact. Compact all backfill to a minimum of 95 percent of the maximum dry density (ASTM D698, Standard Proctor). For cohesive soils, the moisture content at the time of compaction should be adjusted to within -2 and +3 percent of optimum. Place backfill in successive lifts until level with the top of the facing unit.

D. Remove all excess aggregate and other materials from the top of the units before laying up the next course.

E. Place the next course of precast modular block units in running bond with the previous course. Place the web recess over the alignment hoop protruding from the unit below and pull the unit forward to contact the hoop. Given that wall shall be vertical face and not stepped, face of unit should be aligned with the face of the unit below.

F. Continue placing successive courses to the elevations shown on the plans. Construct wall in level stages, placing the units at each course for the entire length of the wall, if possible. Unit fill and backfill should be placed to the level of the top of the facing unit before placing the next course.

G. Provide temporary swales to divert runoff away from wall excavation and away from face.

H. Final grade above and below the retaining wall shall provide for positive drainage and prevent ponding. Protect completed wall from other construction. Do not operate large equipment or store materials above the wall that exceed the design surcharge loads.

3.4 FIELD QUALITY CONTROL

A. The contractor is responsible to ensure that all installation and materials meet the quality specified in the construction drawings. Quality assurance shall include foundation soil inspection and testing and verification of the geotechnical design parameters and verification that the contractor's quality control testing is adequate as a minimum.

B. The contractor shall verify that installation is in accordance with the specifications and construction drawings.

C. The Owner shall/may engage testing and inspection services to provide independent quality construction assurance. This does not relieve the Contractor from securing the necessary construction quality control testing.

D. Compaction testing shall be done a minimum of every 1 foot (300 mm) of vertical fill and every 100 lineal feet) 30 m) along the wall.

E. Testing shall be done at a variety of locations to cover the entire backfill zone. Testing shall verify soil types and strengths, compaction, and moisture conditions.

F. The Contractor shall engage independent inspection and testing services to perform the minimum quality control testing described in the retaining wall design plans and specifications. The professional should perform sufficient testing and observation to verify that wall installation substantially conforms to the design drawings and specifications. Only qualified and experienced technicians and engineers shall perform quality control testing and inspection services.

END OF SECTION

SECTION 32 33 00 – SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Bike Rack (BR)
2. Trash and Recycle Receptacles (LR & RR)
3. Bench (B)
4. Trench Drain Grate (TD)
5. Bollard (BDa & BDb)
6. Privacy Screen (PS)
7. Flag Pole (FPa & FPb)
8. Bike Shelter (BS)
9. Ash Receptacle (AR)
10. Detectable Warning Panels (P3)

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing pipe sleeves cast, formed voids in concrete footings.
2. Section 312000 "Earth Moving" for excavation for installing concrete footings.
3. Division 26 Electrical and Division 23 – Plumbing

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

C. Samples for Initial Selection: For units with factory-applied finishes.

D. Samples for Verification: For each type of exposed finish, not less than 6-inch-long linear components and 4-inch-square sheet components.

E. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

F. Shop Drawings: Submit manufacturer’s shop drawings, including plans and elevations, indicating overall dimensions and materials.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For site furnishings.

1. Wood Preservative Treatment: Include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For site furnishings to be included in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer has been regularly engaged in manufacture of site furnishings since last 25 years. Provide a minimum of five similar reference projects with direct contact information.

B. Product Support: Products are supported with complete engineering drawings.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Bench Replacement Slats: No fewer than 10 full-size units for each size indicated.
2. Trash Receptacle Inner Containers: Five full-size units for each size indicated, but no fewer than two units.
3. Anchors: 15 of each size.

PART 2 - PRODUCTS

2.1 BIKE RACKS

A. Manufacturer: Victor Stanley

B. Style: BRQS-101

C. Color: Powdercoat Black

2.2 TRASH AND RECYCLE RECEPTACLES (LR & RR)

LR

A. Type: SDC-36

B. Capacity: 36 gal.

C. Color: Powdercoat Black

D. Lid: Standard Solid Convex Lid w/ Heavy Steel Latch

E. Galvanized Steel Liner

F. Installation Method: Surface Mounted

G. Contractor to submit order form as part of submittal for landscape architect to select accessories.

RR

H. Manufacturer: Victor Stanley

I. Type: SDC-36

J. Capacity: 36 gal.

K. Color: TBD w/ Recycle Decals

L. Lid: Standard Solid Convex Recycle Lid w/ Heavy Steel Latch

M. Galvanized Steel Liner

N. Installation Method: Surface Mounted

O. Contractor to submit order form as part of submittal for landscape architect to select accessories.

2.3 BENCH (B)

A. Manufacturer: Landscape Forms

B. Model: Socrates

C. Color & Finish: Grey

D. Installation Method: See contract drawings.

2.4 TRENCH DRAIN GRATE (TD)

A. Manufacturer: ACO

B. Model: 437D Longitudinal Galvanized Steel Grate to be compatible with KlassikDrain K100 Channel System

C. Size: 4.84” x 19.69” (to be coordinated with Civil selected drain body)

D. Finish: Galvanized Steel

E. ADA compliant & heel proof

F. Refer to civil drawings for piping and connections.

G. Refer to civil drawings for drain body, size, and compatibility.

2.5 BOLLARDS (BDa & BDb)

A. Manufacturer: Calpipe

B. Style: Dome top

C. Size: 36” height, 9.75” dia

D. Color: Stainless steel

BDA & BDB (Crash Rated Bollard)

E. Manufacturer: Reliance Foundry www.reliance-foundry.com

F. Style: R-1009-04

G. Size: 72” height

H. Color: Stainless Steel

2.6 PRIVACY SCREEN (PS)

A. Manufacturer: Landscape Forms

B. Style: Landscape Panel, One-Inch Horizontal Slat

C. Size: 6’-0 height

D. Surface mounted.

E. Color: Powdercoat Black

2.7 FLAGPOLE (FPa & FPb)

FPa

A. Manufacturer: Federal Flags

B. Style: 30’-0” Commercial Flagpole with External Rope Halyard

C. Overall length: 33’

D. Finish: Satin

E. Flag size: 5’ x 8’

F. Finial: HD Gold Anodized Aluminum Ball

G. Truck: In-Line Truck, Single Revolving

H. Cleat: 7.5’ from bottom – finish to match pole

I. Collar: FC-11 Spun Aluminum

FPb

J. Manufacturer: Federal Flags

K. Height: 25’-0” Commercial Flagpole with External Rope Halyard

L. Overall length: 27’

M. Finish: Satin

N. Flag size: 4’ x 6’

O. Finial: HD Gold Anodized Aluminum Ball; Botonée Cross for pole with Maryland flag (https://www.flagpolestore.com/products/8-botonee-cross.html or approved equal)

P. Truck: In-Line Truck, Single Revolving

Q. Cleat: 7’ from bottom – finish to match pole

R. Collar: FC-11 Spun Aluminum

2.8 BIKE SHELTER (BS)

A. Manufacturer: Bike Depot

B. Style: Ultra Space Saver (8 Bikes)

C. Attachment: Surface Mounted (Per Manufacturer)

D. Color: Powdercoat Black

2.9 Ash Receptacle (AR)

A. Manufacturer: Victor Stanley

B. Style: T-6 Ashtray

C. Color: Powdercoat Black

2.10 DETECTABLE WARNING PANELS (P3)

A. Manufacturer: ADA Solutions

B. Model: Cast-In-Place Replaceable

C. Color: Yellow

2.11 MATERIALS

A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemishes and complying with the following:

1. Rolled or Cold-Finished Bars, Rods, and Wire: ASTM B 211.
2. Extruded Bars, Rods, Wire, Profiles, and Tubes: ASTM B 221.
3. Structural Pipe and Tube: ASTM B 429/B 429M.
4. Sheet and Plate: ASTM B 209.
5. Castings: ASTM B 26/B 26M.

B. Steel and Iron: Free of surface blemishes and complying with the following:

1. Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53/A 53M, or electric-resistance-welded pipe complying with ASTM A 135/A 135M.
3. Tubing: Cold-formed steel tubing complying with ASTM A 500/A 500M.
4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513, or steel tubing fabricated from steel complying with ASTM A 1011/A 1011M and complying with dimensional tolerances in ASTM A 500/A 500M; zinc coated internally and externally.
5. Sheet: Commercial steel sheet complying with ASTM A 1011/A 1011M.
6. Expanded Metal: Carbon-steel sheets, deburred after expansion, and complying with ASTM F 1267.
7. Malleable-Iron Castings: ASTM A 47/A 47M, grade as recommended by fabricator for type of use intended.
8. Gray-Iron Castings: ASTM A 48/A 48M, Class 200.

C. Stainless Steel: Free of surface blemishes and complying with the following:

1. Sheet, Strip, Plate, and Flat Bars: ASTM A 666.
2. Pipe: Schedule 40 steel pipe complying with ASTM A 312/A 312M.
3. Tubing: ASTM A 554.

D. Anchors, Fasteners, Fittings, and Hardware: Stainless steel Manufacturer's standard, corrosion-resistant-coated or non-corrodible materials; commercial quality, tamperproof, vandal and theft resistant, concealed, recessed, and capped or plugged.

1. Angle Anchors: For inconspicuously bolting legs of site furnishings to below-grade substrate; one per leg.
2. Antitheft Hold-Down Brackets: For securing site furnishings to substrate; two per unit extent as indicated on Drawings.

E. Non-shrink, Nonmetallic Grout: Premixed, factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M; recommended in writing by manufacturer, for exterior applications.

F. Erosion-Resistant Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.

G. Galvanizing: Where indicated for steel and iron components, provide the following protective zinc coating applied to components after fabrication:

1. Zinc-Coated Tubing: External, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, polymer film. Internal, same as external or consisting of 81 percent zinc pigmented coating, not less than 0.3 mil thick.
2. Hot-Dip Galvanizing: According to ASTM A 123/A 123M, ASTM A 153/A 153M, or ASTM A 924/A 924M.

2.12 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment: Pressure-treat wood according to AWPA U1 and the following:

1. Use preservative chemicals acceptable to authorities having jurisdiction and containing no arsenic or chromium. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
2. Kiln-dry lumber and plywood after treatment to a maximum moisture content, respectively, of 19 and 15 percent. Do not use materials that are warped or do not comply with requirements for untreated materials.

2.13 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Preservative-Treated Wood Components: Complete fabrication of treated items before treatment if possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces.

E. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

F. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.14 GENERAL FINISH REQUIREMENTS

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.15 ALUMINUM FINISHES

A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.16 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

B. PVC Finish: Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added; complying with coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness.

2.17 IRON FINISHES

A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.18 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run directional finishes with long dimension of each piece.
2. Dull Satin Finish: No. 6

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Notify architect of conditions that would adversely affect installation or subsequent use.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored and positioned at locations indicated on Drawings.

D. Finish and repair any damages caused to finish or product in accordance with manufacturer’s instructions and as approved by Landscape Architect.

E. Component Damage: Remove and replace damaged components that cannot be successfully repaired as determined by Landscape Architect.

F. Clean products promptly after installation in accordance with manufacturer’s instructions. Do not use harsh cleaning materials or methods that could damage finish.

G. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

H. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

I. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

END OF SECTION 32 33 00

SECTION 32 91 13 - SOIL PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

C. Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials, dated July, 2023 and as amended.

D. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition. Alternate methods and/or materials may be submitted to the Architect for consideration and the Owner for approval. Those judged to be equal to that specified will receive written approval unless otherwise noted within these specifications.

E. 2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control, and as amended.

1.2 SUMMARY

A. Section includes planting soils specified by composition of the mixes.

B. Planting Soil

C. Topsoil (Screened)

D. Potting Soil for planter pots

E. Related Requirements:

1. Section 32 33 00 "Site Furnishings" for placing planting soil in exterior unit planters.
2. Section 31 10 00 "Site Clearing" for topsoil stripping and stockpiling.
3. Section 32 92 00 "Turf and Grasses" for placing planting soil for turf and grasses.
4. Section 32 93 00 "Plants" for placing planting soil for plantings.

1.3 ALLOWANCES

A. Preconstruction and field quality-control testing are part of testing and inspecting allowance.

1.4 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.5 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

F. Imported Soil: Soil that is transported to Project site for use.

G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.

H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

M. SSSA: Soil Science Society of America.

N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

Q. USCC: U.S. Composting Council.

1.6 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.7 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:

a. Manufacturer's qualified testing agency's certified analysis of standard products.
b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

B. Samples: For each bulk-supplied material, 1 quart (0.95 L) volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

C. Material test reports from qualified independent testing agency, recommended by the University of Maryland indicating and interpreting test results relative to compliance of the following materials with requirements indicated.

1. Analysis of existing surface soil. At least 3 random composite tests in Owner defined areas.
2. Analysis of imported topsoil. At least 3 random composite tests (Owner defined) per location.
3. Topsoil analysis converted to Maryland FIV figures and used to prepare a report of suitability of topsoil for plant growth and required amendments by a Turfgrass Agronomist or Certified Arborist familiar with Maryland’s climatic conditions and Maryland's unique growing conditions.
4. Analysis of subsoil. At least 3 random composite tests in Owner Defined Areas.
5. Subsoil analysis converted to Maryland FIV figures and used to prepare a report of suitability of topsoil for plant growth and required amendments by a Turfgrass Agronomist or Certified Arborist familiar with Maryland’s climatic conditions and Maryland's unique growing conditions.
6. All fertility and amendment recommendations must comply with Maryland's Nutrient Management and Maryland's Fertilizer Applicator Laws and Regulations.

D. Delivery ticket noting quantity and location/source of imported topsoil per truck load.

1.8 INFORMATIONAL SUBMITTALS

A. Qualification Data: For each testing agency.

B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.

C. Field quality-control reports.

1.9 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1. Soil Testing Laboratory Qualifications: The soil testing shall be completed by an independent laboratory, recognized by the Maryland Department of Agriculture with experience and capability to conduct the testing indicated including but not limited to soil texture, pH, macro and micro nutrient levels, soluble salts, Cation Exchange Capacity and organic matter in a timely manner to prevent delays.

A&L Eastern Agricultural Laboratories
Inc. 7621 Whitepine Road
Richmond, VA 23237

Agri Analysis,
P.O. Box 483
280 Newport Road
Leola, PA 17540

Brookside Laboratories, Inc.
tory 308 East Main St.
New Knoxville, OH 45871

Agricultural Analytical Services Labora-
Pennsylvania State University
University Park, PA 16802

Spectrum Analytic Inc.
P.O. Box 639
1087 Jamison Road
Washington Court House, OH 43160
1303

University of Delaware
Soil Testing Program
149 Townsend Hall
Newark, DE 19717-

Waters Agricultural Laboratories,
Inc. 257 Newton Highway
P.O. Box 382
Camille, GA 31730-0382

1.10 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil and / or imported soil.

1. Notify Architect seven days in advance of the dates and times when laboratory samples will be taken.

B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

1. Topsoil Analysis for Existing and Imported Material: Furnish soil analysis from a qualified soil testing laboratory stating as a minimum the percentages of organic matter; soil texture (gradations of sand, silt and clay) with the USDA soil classification; cation exchange capacity; soluble salts; pH and the macro and micro mineral content.
2. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements. A report of the suitability of the topsoil for plant growth shall be provided. The report shall include the conversion of the laboratory test results to Maryland FIV figures before the recommended quantities of organic matter, nitrogen, phosphorus, potassium, calcium, and magnesium plus any needed micro nutrients soil amendments to produce satisfactory topsoil within the scope of the Maryland State Nutrient Management and the Maryland Fertilizer Applicator Laws and Regulations. This report should be completed by a Turfgrass Agronomist, a Certified Arborist, or similar individual who is familiar with Maryland's unique turfgrass growing conditions and can make the fertility recommendations within the Maryland regulations and the specifications of this project.

3. Baltimore County Office of Budget and Finance reserves the right to have their samples also tested by the same accredited laboratory for determining compliance and uniformity of the amendments and the topsoil.

    a. If the tests indicate the topsoil to be within expected variations after amendments have been applied, then Baltimore County Office of Budget and Finance shall pay for the soil testing.
    b. If the tests are found to be outside the expected variations the contractor shall pay for the testing and shall amend the soil further to comply with these soil tests and or remove and replace the topsoil.

1.11 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by state-certified, -licensed, or -registered soil scientist under the direction of the testing agency.

1. Number and Location of Samples: Minimum of three representative soil samples from varied locations for each soil to be used or amended for landscaping purposes.
2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.12 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. The contractor shall pay the cost of the soil testing and suitability reporting.

C. All soil testing shall be performed by the same laboratory.

D. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis by the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":

    a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
    b. Hydrometer Method: Report percentages of sand, silt, and clay.

2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D698 (Standard Proctor).

E. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.

F. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT NEC-67, including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm.
14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

G. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

H. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. (92.9 sq. m) for 6-inch (152.4 mm) depth of soil.
2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. (92.9 sq. m) for 6-inch (152.4 mm) depth of soil.

1.13 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 MATERIALS

2.2 PLANTING SOILS SPECIFIED BY COMPOSITION

A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

B. Planting-Soil Type: Existing, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site; modified to produce viable planting soil. Blend existing, on-site surface soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

1. Particle Size Distribution by USDA Textures: Classified as sandy loam, loam, silt loam, loamy sand, or clay loam soil according to USDA textures.
2. Topsoil shall meet the analysis of sand, silt, and clay when determined in accordance with ASSHTO T 88 with the following exceptions:

Fraction Sizes	Percentage Passing by Weight
Sand (2.0-0.050 mm)	20-75
Silt (0.050-0.002 mm)	10-60
Clay (less than 0.002 mm)	5-18

3. Ratio of Loose Compost to Soil: 1:4 by volume.
4. Percentage of Organic Matter: Minimum 3 percent by volume.
5. Where the subsoil is either highly acidic or composed of heavy clays, spread ground limestone at the rate of 4 to 8 tons/acre (183.7-367.31 pounds per 1,000 square feet) prior to the placement of topsoil.
6. Weight of Slow-Release Fertilizer: 15 pounds per 1000 sq. ft. (92.9 sq. m) per 3-5 inches of soil depth.

C. Planting-Soil Type: Imported, naturally formed soil from off-site sources and consisting of sandy loam, loam, silt loam, loamy sand, or clay loam soil according to USDA textures and modified to produce viable planting soil.

1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches (101.6 mm) deep, not from agricultural land, bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass.
    a. Imported soils may not include the following:
        1) Any soils defined regionally by the Natural Resources Conservation Service (NRCS) web soil survey (or local equivalent for projects outside the U.S.) as prime farmland, unique farmland, or farmland of statewide or local importance;

2) Soils from other greenfield sites; or
3) Sphagnum peat moss.

2. Additional Properties of Imported Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 2 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.

3. Unacceptable Properties: Clean soil of the following:

   a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
   b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
   c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1 inches (25.4 mm) in any dimension.

4. Amended Soil Composition: Blend imported, unamended soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

   a. Ratio of Loose Compost to Soil: 1:4 by volume.
   b. Weight of Slow-Release Fertilizer: 50 pounds per 1000 sq. ft. (92.9 sq. m) per 6 inches (152.4 mm) of soil depth.

D. Planting-Soil Type: Manufactured soil consisting of manufacturer's basic topsoil, sandy loam according to USDA textures, blended in a manufacturing facility with sand, stabilized organic soil amendments, and other materials to produce viable planting soil.

1. Additional Properties of Manufacturer's Basic Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 3 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.

2. Unacceptable Properties: Manufactured soil shall not contain the following:

   a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
   b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the manufactured soil.
   c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1-1/2 inches (38.1 mm) in any dimension.

3. Blend manufacturer's basic soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

   a. Ratio of Loose Compost to Soil: 1:4 by volume.
   b. Weight of Lime: 50 pounds per 1,000 square feet (92.9 sq. m).
   c. Ureaform fertilizer – Application Rate: 15 pounds per 1,000 square feet unless otherwise directed.
   d. Weight of Commercial Fertilizer: 5-10-10 Fertilizer at rate of 50 pounds per 1,000 square feet (92.9 sq. m).

E. Screened Topsoil for all planting area

1. Imported topsoil or manufactured topsoil that has been modified as specified with soil amendments to produce a soil mixture best for plant growth. Using soil analyses and materials specified in other articles of this Section. Topsoil to be screened topsoil.

    a. Particle Size Distribution by USDA Textures: Classified as sandy loam soil according to USDA textures.
    b. Percentage of organic matter: Minimum 6 percent by volume.
    c. Soil Reaction: pH of 6 to 7.

2. Unacceptable properties: Clean soil of the following:

    a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the manufactured soil.
    c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1-1/2 inches (38.1 mm) in any dimension.

F. Potting Soil for all Planter Pots

1. Manufacturer: Pro-Mix Premium Potting Mix
2. Install filter fabric, drainage aggregate, insulation as shown in contract documents.
3. Refer to contract documents for accessories and layering information.

2.3 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through a No. 8 (2.36 mm) sieve and a minimum of 75 percent passing through a No. 60 (0.25 mm) sieve.

2.4 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:

1. Feedstock: Limited to leaves May include animal waste.
2. Reaction: pH of 5.5 to 8.
3. Soluble-Salt Concentration: Less than 4 dS/m.
4. Moisture Content: 35 to 55 percent by weight.
5. Organic-Matter Content: 30 to 40 percent of dry weight.
6. Particle Size: Minimum of 98 percent passing through a 1 inch (25.4 mm) sieve.

B. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.5 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. (0.5 kg/100 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

C. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

C. Proceed with placement only after unsatisfactory conditions have been corrected.

D. All areas that are on-structure are to receive lightweight soil (planting or structural) as noted in the contract drawings for the entire depth (i.e. from finished grade condition to the top of slab) as shown in the contract drawings.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches (152.4 mm) and stockpile until amended.

B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

C. Unsuitable Materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

D. Screening: Pass unamended soil through a 2 inch (50.8 mm) sieve to remove large materials.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 6 inches (152.4 mm). Remove stones larger than 1-1/2 inches (38.1 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 4 inches (101.6 mm) of subgrade. Spread remainder of planting soil.

C. Mixing: Spread unamended soil to total depth of 4 inches (101.6 mm), but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Amendments: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.

a. Mix lime with dry soil before mixing fertilizer.
b. Mix fertilizer with planting soil no more than seven days before planting.

2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches (203.2 mm) in loose depth for material compacted by compaction equipment, and not more than 6 inches (152.4 mm) in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698 and tested in-place.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply manufactured soil on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 6 inches (152.4 mm). Remove stones larger than 1-1/2 inches (38.1 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply approximately half the thickness of planting soil over prepared, loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.

C. Application: Spread planting soil to total depth of 6 inches (152.4 mm), but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Lifts: Apply planting soil in lifts not exceeding 8 inches (203.2 mm) in loose depth for material compacted by compaction equipment, and not more than 6 inches (152.4 mm) in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 BLENDING PLANTING SOIL IN PLACE

A. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Preparation: Till unamended, existing soil in planting areas to a minimum depth of 6 inches (152.4 mm). Remove stones larger than 1-1/2 inches (38.1 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

C. Mixing: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them into full depth of unamended, in-place soil to produce planting soil.

1. Mix lime with dry soil before mixing fertilizer.
2. Mix fertilizer with planting soil no more than seven days before planting.

D. Compaction: Compact blended planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.6 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

A. Application: Apply compost component of planting soil mix 4 inches (101.6 mm) of compost to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D698. Space tests at no less than one for each 1000 sq. ft. (92.9 sq. m) of in-place soil or part thereof.

C. Soil will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.8 PROTECTION

A. Protection Zone: Identify protection zones according to Section 01 56 39 "Temporary Tree and Plant Protection."

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.

C. If planting soil or subgrade is over compacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.9 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION

SECTION 32 92 00 – TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Seeding
2. Sodding

B. Related Requirements:

1. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.
2. Section 334600 "Subdrainage" for below-grade drainage of landscaped areas.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329115 "Soil Preparation (Performance Specification)" and drawing designations for planting soils.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.5 PRODUCT DATA SUBMITTALS

A. LEED Submittals: Comply with Section 018113.
   1. SS Credit 2: Protect or Restore Habitat.
      a. Provide documentation that confirms all criteria listed in Part 2 of this section is met for all imported soils.
   2. Imported soils: Comply with the following criteria:
      a. Original function is comparable to reuse function.
      b. Not classified as prime farmland, unique farmland, or farmland of statewide or local importance.
      c. Not extracted from a greenfield site.
      d. Does not include sphagnum peat moss.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

   1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

   1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
   2. Experience: Five years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
   3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
   4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

a. Landscape Industry Certified Technician - Exterior.
b. Landscape Industry Certified Lawncare Manager.
c. Landscape Industry Certified Lawncare Technician.

5. Pesticide Applicator: State licensed, commercial.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.10 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: April 1 to May 15
2. Fall Planting: September 1 to October 15

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:

1. Quality: State-certified seed of grass species as listed below for solar exposure.
2. Quality: Seed of grass species as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:
3. Full Sun: Kentucky bluegrass (Poa pratensis), a minimum of three cultivars.
4. Sun and Partial Shade: Proportioned by weight as follows:

    a. 90 percent Tall Turf Type Fescue (Festuca arundinacea).
    b. 10 percent Imported Kentucky Bluegrass (Poa pratensis).

5. Shade: Proportioned by weight as follows:

    a. 50 percent chewings red fescue (Festuca rubra variety).
    b. 35 percent rough bluegrass (Poa trivialis).
    c. 15 percent redtop (Agrostis alba).

2.2 TURFGRASS SOD

A. Turfgrass Sod: Certified and approved and Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.

B. Manufacturer: Royal Sod Farms, LLC

C. Product: Royal Sod Fescue Blend

- Barvado Tall Fescue
- Xtreme Green Tall Fescue
- Titanium Tall Fescue
- Raven KY Blue (less than 10%)

D. Turfgrass Species: Sod of grass species, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed

E. MD preferred sod mix - 3 species of tall fescue and max. 5% of Bluegrass

2.3 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.4 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Sphagnum Peat Mulch: Partially decomposed sphagnum peat moss, finely divided or of granular texture, and with a pH range of 3.4 to 4.8.

C. Muck Peat Mulch: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.

D. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; bio-solids; yard trimmings; or source-separated or compostable mixed solid waste.

E. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

F. Non asphaltic Tackifier: Colloidal Tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

G. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.5 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydro seeding and hydro mulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329115 "Soil Preparation" – for planting soil.

B. Placing Planting Soil: Place manufactured planting soil over exposed subgrade.

1. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.

1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
2. Do not use wet seed or seed that is moldy or otherwise damaged.
3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of 5 to 8 lb/1000 sq. ft..

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.

F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft.. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

G. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch or peat mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch, and roll surface smooth.

3.5 HYDROSEEDING

A. Hydroseeding: Mix specified seed, slow-release fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with fiber-mulch manufacturer's recommended tackifier.
2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.

3. Spray-apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre.

3.6 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.7 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of

grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow bentgrass to a height of 1/2 inch or less.
2. Mow bermudagrass to a height of 1/2 to 1 inch.
3. Mow Kentucky bluegrass to a height of 1-1/2 to 2 inches.
4. Mow turf-type tall fescue to a height of 2 to 3 inches.

D. Turf Postfertilization: Apply slow-release fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.8 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.9 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.10 PLUGGING

Plant plugs in holes or furrows, spaced 12 inches apart in a triangular pattern.

3.11 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove non-degradable erosion-control measures after grass establishment period.

3.12 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Seeded Turf: 60 days from date of planting completion.

    a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

2. Sodded Turf: 60 days from date of planting completion.

END OF SECTION 32 92 00

SECTION 32 93 00 – PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plants
2. Tree stabilization
3. Tree-watering devices
4. Landscape edgings

B. Related Requirements:

1. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Section 329200 "Turf and Grasses" for turf (lawn), hydroseeding, and erosion-control materials.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

G. Finish Grade: Elevation of finished surface of planting soil.

H. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

I. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

J. Planting Area: Areas to be planted.

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329115 "Soil Preparation (Performance Specification)" for drawing designations for planting soils.

L. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

M. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

N. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

O. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.5 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. LEED Submittals: Comply with Section 018113.

1. SS Credit 2: Protect or Restore Habitat

2. Provide documentation that confirms all criteria listed in Part 2 of this Section is met for all imported soils.

C. Samples for Verification: For each of the following:

1. Trees and Shrubs: Three Samples of each variety and size delivered to site for review. Maintain approved Samples on-site as a standard for comparison.
2. Organic Compost Mulch: 1-quart volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
3. Weed Control Barrier: 12 by 12 inches.
4. Proprietary Root-Ball-Stabilization Device: One unit.
5. Slow-Release, Tree-Watering Device: One unit of each size required.
6. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
7. Tree Grates, Frames, and Accessories: Manufacturer's standard size delivered to site for review, to verify design and color selected.
8. Root Barrier: Width of panel by 12 inches.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

D. Sample Warranty: For special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Five years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

    a. Landscape Industry Certified Technician - Exterior.
    b. Landscape Industry Certified Horticultural Technician.

5. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1. Selection of plants purchased under allowances is made by Architect, who tags plants at their place of growth before they are prepared for transplanting.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Deliver bare-root stock plants within 24 hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.

D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

I. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.

2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.11 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: April 1 to May 15
2. Fall Planting: September 1 to October 15

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.12 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
b. Structural failures including plantings falling or blowing over.
c. Faulty performance of tree stabilization, edgings and tree grates.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods: From date of Substantial Completion.

a. Trees, Shrubs, Vines, and Ornamental Grasses: 24 months.
b. Ground Covers, Biennials, Perennials, and Other Plants: 24 months.
c. Annuals: Three months.

3. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.

c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Do not use nurseries that have a different soil structure than Maryland’s (e.g. do not use nurseries from the South, Tennessee and Georgia to name a few)

C. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

D. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

E. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

F. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

G. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

H. Do not install plants if they appear to be damaged during transit or on site.

I. Trees to be protected during transit so that they do not get wind burn etc.

J. Imported soils: Comply with the following criteria:

Original function is comparable to reuse function

Not classified as prime farmland, unique farmland or farmland of statewide or local importance

Not extracted from a greenfield site

Does not include sphagnum peat moss

2.2 FERTILIZERS

A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 5-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 PLANT WATERING DEVICES

A. Shade trees

Manufacturer: TreeGator Original, www.treegator.com (size of bag dependent on tree size)

B. Evergreen and multi-stem trees:

Manufacturer: TreeGator Jr. Pro, www.treegator.com (size of bag dependent on tree size)

2.4 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood.
2. Size Range: 3 inches maximum, 1/2 inch minimum.
3. Color: Natural.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 1-inch sieve; soluble-salt content of 2 to 5 dS/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; bio-solids; yard trimmings; or source-separated or compostable mixed solid waste.

2.5 WEED-CONTROL BARRIERS

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.

B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd..

2.6 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.7 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
2. Wood Deadmen: Timbers measuring 8 inches in diameter and 48 inches long, treated with specified wood pressure-preservative treatment.
3. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or turnbuckles or compression springs.
4. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch in diameter.
5. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
6. Guy Cables: Five-strand, 3/16-inch-diameter, galvanized-steel cable, with zinc-coated turnbuckles or compression springs, a minimum of 3 inches long, with two 3/8-inch galvanized eyebolts.
7. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.
8. Proprietary Staking-and-Guying Devices: Proprietary stake or anchor and adjustable tie systems to secure each new planting by plant stem; sized as indicated and according to manufacturer's written recommendations.
   a. Platipus anchoring system (http://www.platipus-anchors.us/)

B. Root-Ball Stabilization Materials:

1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by

length indicated (min. 8'-0 out of ground and 2'-0 underground); stakes pointed at one end.

2. Wood Screws: ASME B18.6.1.
3. Proprietary Root-Ball Stabilization Devices: Proprietary at- or below-grade stabilization systems to secure each new planting by root ball and that do not encircle the trunk; sized according to manufacturer's written recommendations unless otherwise indicated.
   a. Platipus anchoring system – Plati Mat – model # depends on size of the tree specified in planting schedule (http://www.platipus-anchors.us/)

2.8 LANDSCAPE EDGINGS

A. Steel Edging: Standard commercial-steel edging, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.

1. Border Concepts Steel Edging (Border King)
2. Edging Size: 1/4 inch thick by 5 inches deep.
3. Stakes: Tapered steel, a minimum of 12 inches long.
4. Accessories: Standard tapered ends, corners, and splicers.
5. Finish: Manufacturer's standard paint.

   a. Paint Color: Contractor to submit all manufacturer colors for approval.

2.9 MISCELLANEOUS PRODUCTS

A. Wood Pressure-Preservative Treatment: AWPA U1, Use Category UC4a; acceptable to authorities having jurisdiction, and containing no arsenic or chromium.

B. Root Barrier: Black, molded, modular panels 24 inches high (deep), 85 mils thick, and with vertical root deflecting ribs protruding 3/4 inch out from panel surface; manufactured with minimum 50 percent recycled polyethylene plastic with UV inhibitors.

C. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

D. Burlap: Non-synthetic, biodegradable.

E. Planter Drainage Gravel: Washed on site after delivery with no fines, #57 stone.

F. Planter Filter Fabric: Nonwoven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.

G. Concrete Parking Stops: For anchoring trees on structure. Use minimum 3 parking stops per tree. 200 lbs+ per parking stop minimum weight. Parking stops to be installed prior to infilling soil trench. Document via photos that the parking stops were installed correctly for each tree pit.

H. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Lay out plants at locations directed by Landscape Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329115 "Soil Preparation."

B. Placing Planting Soil: Place manufactured planting soil over exposed subgrade.

C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

D. Application of Mycorrhizal Fungi: At time directed by Architect, broadcast dry product uniformly over prepared soil at application rate according to manufacturer's written recommendations.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.
   1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable and will be rejected.
   2. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
   3. Excavate three times as wide as ball diameter for balled and Burlapped, balled and potted, container-grown and fabric bag-grown stock.
   4. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
   5. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
   6. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
   7. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
   8. Maintain supervision of excavations during working hours.
   9. Keep excavations covered or otherwise protected after working hours.
   10. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Backfill Soil: Subsoil and topsoil removed from excavations may not be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

   1. Hardpan Layer: Drill 6-inch-diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow it to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Inspection: Contractor to layout all plants prior to installation and get landscape architect’s approval on the layout. Installation to occur only after landscape architect has approved the layout. Contractor to notify landscape architect minimum 7 days in advance for conducting a site visit to approve the planting layout. Layout of plants to be in accordance with contract documents.

B. At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

C. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

D. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.

1. Backfill: Planting soil. For trees, use excavated soil for backfill.
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.

    a. Quantity: Two per plant.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. Balled and Potted and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches above Insert requirement adjacent finish grades.

1. Backfill: Planting soil. For trees, use excavated soil for backfill.
2. Carefully remove root ball from container without damaging root ball or plant.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.

    a. Quantity: Two per plant.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

F. Fabric Bag-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.

1. Backfill: Planting soil. For trees, use excavated soil for backfill.
2. Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.

    a. Quantity: Two per plant.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

G. Bare-Root Stock: Set and support each plant in center of planting pit or trench with root flare 2 inches above adjacent finish grade.

1. Backfill: Planting soil. For trees, use excavated soil for backfill.
2. Spread roots without tangling or turning toward surface. Plumb before backfilling, and maintain plumb while working.
3. Carefully work backfill in layers around roots by hand. Bring roots into close contact with the soil.
4. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
5. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside soil-covered roots about 1 inch from root tips; do not place tablets in bottom of the hole or touching the roots.

    a. Quantity: Two per plant.

6. Continue backfilling process. Water again after placing and tamping final layer of soil.

H. Watering Pipe: During backfilling, install watering pipe 4 feet deep into the planting pit outside the root ball with top of pipe 1 inch above the mulched surface.

I. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 MECHANIZED TREE-SPADE PLANTING

A. Trees may be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.

B. Use the same tree spade to excavate the planting hole as will be used to extract and transport the tree.

C. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.

D. Cut exposed roots cleanly during transplanting operations.

E. Plant trees following procedures in "Tree, Shrub, and Vine Planting" Article.

F. Where possible, orient the tree in the same direction as in its original location.

3.7 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.

C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.8 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:

1. Upright Staking and Tying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend one-third of trunk height above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
2. Upright Staking and Tying: Stake trees with two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
3. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
4. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

B. Trunk Stabilization by Staking and Guying: Install trunk stabilization as follows unless otherwise indicated on Drawings. Stake and guy trees more than 14 feet in height and more than 3 inches in caliper unless otherwise indicated.

1. Site-Fabricated, Staking-and-Guying Method: Install no fewer than three guys spaced equally around tree.

    a. Securely attach guys to stakes 30 inches long, driven to grade. Adjust spacing to avoid penetrating root balls or root masses. Provide turnbuckle or compression spring for each guy wire and tighten securely.
    b. For trees more than 6 inches in caliper, anchor guys to wood deadmen buried at least 36 inches below grade. Provide turnbuckle or compression spring for each guy wire and tighten securely.
    c. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle or compression spring. Allow enough slack to avoid rigid restraint of tree.

d. Support trees with guy cable, connected to the brass grommets of tree-tie webbing at contact points with tree trunk and reaching to turnbuckle or compression spring. Allow enough slack to avoid rigid restraint of tree.
e. Attach flags to each guy wire, 30 inches above finish grade.
f. Paint turnbuckles or compression springs with luminescent white paint.

2. Proprietary Staking and Guying Device: Install staking and guying system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

C. Root-Ball Stabilization: Install at- or below-grade stabilization system to secure each new planting by the root ball unless otherwise indicated.

1. Wood Hold-Down Method: Place vertical stakes against side of root ball and drive them into subsoil; place horizontal wood hold-down stake across top of root ball and screw at each end to one of the vertical stakes.

a. Install stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation. Saw stakes off at horizontal stake.
b. Install screws through horizontal hold-down and penetrating at least 1 inch into stakes. Predrill holes if necessary to prevent splitting wood.
c. Install second set of stakes on other side of root trunk for larger trees.

2. Proprietary Root-Ball Stabilization Device: Install root-ball stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

3.9 ROOT-BARRIER INSTALLATION

A. Install root barrier where trees are planted within 60 inches of paving or other hardscape elements, such as walls, curbs, and walkways, unless otherwise indicated on Drawings.

B. Align root barrier with bottom edge angled at 20 degrees away from the paving or other hardscape element and run it linearly along and adjacent to the paving or other hardscape elements to be protected from invasive roots.

C. Install root barrier continuously for a distance of 60 inches in each direction from the tree trunk, for a total distance of 10 feet per tree. If trees are spaced closer, use a single continuous piece of root barrier.

1. Position top of root barrier according to manufacturer's written recommendations.
2. Overlap root barrier a minimum of 12 inches at joints.
3. Do not distort or bend root barrier during construction activities.
4. Do not install root barrier surrounding the root ball of tree.

3.10 PLACING SOIL IN PLANTERS

A. Place a layer of drainage gravel at least 4 inches thick in bottom of planter. Cover bottom with filter fabric and wrap filter fabric 6 inches up on all sides. Duct tape along the entire top edge of the filter fabric, to secure the filter fabric against the sides during the soil-filling process.

B. Fill planter with planting soil. Place soil in lightly compacted layers to an elevation of 1-1/2 inches below top of planter, allowing natural settlement.

3.11 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.12 PLANTING AREA MULCHING

A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches and secure seams with galvanized pins.

B. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees and Treelike Shrubs in Turf Areas: Apply organic or mineral mulch ring of 2-inch average thickness, with 36-inch radius around trunks or stems. Do not place mulch within 6 inches of trunks or stems.
2. Organic Mulch in Planting Areas: Apply 2-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 6 inches of trunks or stems.
3. Mineral Mulch in Planting Areas: Apply 2-inch average thickness of mineral mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 6 inches of trunks or stems.

3.13 EDGING INSTALLATION

A. Steel Edging: Install steel edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches apart, driven below top elevation of edging.

B. Shovel-Cut Edging: Separate mulched areas from turf areas, curbs, and paving with a 45-degree, 4- to 6-inch-deep, shovel-cut edge.

C. Mow-Strip Installation:

1. Excavate for mow strip.
2. Compact subgrade uniformly beneath mow strip.
3. Apply nonselective, pre-emergent herbicide that inhibits growth of grass and weeds.
4. Install steel edging, delineating the edge of mow strip.
5. Install weed-control barrier before mulching, covering area of mow strip, and overlapping and pinning edges of barrier at least 6 inches and according to manufacturer's written instructions.
6. Place indicated thickness of organic or mineral mulch, fully covering weed barrier.
7. Rake mulch to a uniform surface level with adjacent finish grades.

3.14 INSTALLING SLOW-RELEASE WATERING DEVICE

A. Provide one device for each tree.

B. Place device on top of the mulch at base of tree stem and fill with water according to manufacturer's written instructions.

3.15 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, and watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.16 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.17 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size as those being replaced for each tree of 6 inches or smaller in caliper size.
2. Provide two new tree(s) of 6-inch caliper size for each tree being replaced that measures more than 6 inches in caliper size.
3. Species of Replacement Trees: Species selected by Architect.

3.18 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.19 MAINTENANCE SERVICE

A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: 24 months from date of Substantial Completion.

B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin

maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: 12 months from date of Substantial Completion.

END OF SECTION 32 93 00

SECTION 33 10 00 - WATER UTILITIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

C. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition. Alternate methods and/or materials may be submitted to the Architect for consideration. Those judged to be equal to that specified will receive written approval.

1.2 SUMMARY

A. This Section includes water systems piping for potable water service and fire protection service outside the building.

B. Related Specifications: The following standard specifications are made a part of this specification to the extent referenced herein.

1. Baltimore County "Standard Specifications for Construction," with current revisions. Delete all references to method of Measure and basis of Payment.
2. National Fire Protection Association "Standard for Installation of Private Fire Supply Mains and Their Appurtenances - NFPA 24".

C. Related Sections:

1. Division 21 00 00: Fire Suppression
2. Division 22 00 00: Plumbing
3. Section 31 23 00: Excavating and Filling

1.3 PERFORMANCE REQUIREMENTS

A. The Contractor will be responsible for securing all appropriate utility permits, including but not limited to a Capitol Connection permit and an on-site water permit.

B. Minimum Pressure Rating: Except where otherwise indicated, the following are minimum pressure requirements for water system piping.

1. Underground Piping: 280 psig with an actual operating pressure of 125 psig.
2. All materials shall be in accordance with the requirements of the Baltimore County Plumbing Code and the Baltimore County Department of Public Works.

1.4 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division I Specification

Sections.

B. Product data for the following:

1. Identification materials and devices.

C. Shop drawings for the following: piping; valves; valve vaults; tapping valve; water meter; motor vault; bends and fire hydrants.

D. Coordination drawings showing pipe sizes and elevations. Include details for connections, anchors, and reaction backing. Show other piping in same trench and clearances from water system piping. Indicate interface and spatial relationship between piping and proximate structures.

E. Record drawings at Project closeout of installed water system piping and products according to Division 1 Section “Closeout Procedures”.

F. Test reports specified in “Field Quality Control” Article in Part 3.

1.5 QUALITY ASSURANCE

A. Comply with standards of authorities having jurisdiction for fire protection systems. Include materials, hose threads, installation, and testing.

B. Comply with standards of authorities having jurisdiction for potable water piping and plumbing systems. Include materials, installation, testing, and disinfection.

C. Comply with NFPA 24 “Standards for the Installation of Private Fire Service Mains and Their Appurtenances” for materials, installations, tests and flushing.

D. Listing and Labeling: Provide equipment and accessories that are listed and labeled.

1. The Terms “Listed and Labeled”: As defined in “National Electrical Code,” Article 100.
2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.

E. Product Options: Water systems specialties and accessories are based on specific types, manufacturers, and model indicated. Components by other manufacturers but having equal performance characteristics may be considered, provided deviations in dimensions, operation, and other characteristics do not change design concept or intended performance as judged by Architect. The burden of proof of equality of products is on Contractor. Refer to Division 1 Section “Substitutions.”

F. In the event of a discrepancy between the Project Specifications, Construction Documents, Baltimore County Standard Specifications and Details, or other guidelines set forth by the authorities having jurisdiction, the more stringent will apply.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling, to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

A. Site Information: Data obtained from a field survey & plans obtained from Baltimore County were used for the basis of the design. The Owner, Architect or Engineer will not be responsible for interpretations or conclusions drawn from this data by the Contractor.

1. Additional test bores and other exploratory operations may be performed by the Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.

B. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Architect and then only after acceptable temporary utility services have been provided. If existing utilities are indicated to be abandoned, the Contractor shall remove such utility, if necessary, at no additional cost to the Owner.

1. Provide a minimum 48-hours notice to the Architect and receive written notice to proceed before interrupting any utility.

C. Should uncharted or incorrectly charted, piping, or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

D. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights. Open trench excavations within the limits of the right-of-way shall be protected in accordance with the requirements of applicable permits. Open excavation within other roadways shall be plated and shall be posted with warning devices in accordance with the Manual on Uniform Traffic Control Devices.

1. Perform excavation by hand within dripline of large trees to remain. Protect root systems from damage or dryout to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with moistened burlap.
2. Work which affects the public right-of-way shall be in accordance with Baltimore County requirements and regulations based on the Ownership of the affected road.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate with pipe materials, sizes, entry locations, and pressure requirements of building fire protection systems piping.

B. Coordinate with pipe materials, sizes, and entry locations, and pressure requirements of building water distribution systems piping.

C. Coordinate with other utility work.

D. Coordinate electrical requirements of actual equipment furnished with requirements specified in Division 16.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Drilling Machine Corporation Stops:

   a. Ford Meter Box Co., Inc.
   b. Hays Div., Romac Industries.
   c. Mueller Co., Grinnell Corp.

2. Bronze Corporation Stops and Valves:

   a. Ford Meter Box Co., Inc.
   b. Hays Div., Romac Industries.
   c. A.Y. McDonald Mfg. Co.
   d. Mueller Co., Grinnell Corp.

3. Tapping Valves:

   a. Clow Valve Co. Div., McWane, Inc.
   b. East Jordan Iron Works, Inc.
   c. Kennedy Valve Div., McWane, Inc.
   d. Mueller Co., Grinnell Corp.
   e. U.S. Pipe & Foundry Co.

4. Gate Valves:

   a. American Darling Valve Div., American Cast Iron Pipe Co.
   b. Clow Valve Co. Div., McWane, Inc.
   c. East Jordan Iron Works, Inc.
   d. Gem Sprinkler Co. Div., Grinnell Corp.
   e. Hammond Valve Corp.
   f. Kennedy Valve Div., McWane, Inc.
   g. Milwaukee Valve Co., Inc.
   h. Mueller Co., Grinnell Corp.
   i. Nibco, Inc.
   j. Stockham Valves & Fittings, Inc.
   k. U.S. Pipe & Foundry Co.
   l. Waterous Co.

5. Dry-Barrel Fire Hydrants:

   a. American Darling Valve Div., American Cast Iron Pipe Co.
   b. Clow Valve Co. Div., McWane, Inc.
   c. East Jordan Iron Works, Inc.
   d. Kennedy Valve Div., McWane, Inc.
   e. Mueller Co., Grinnell Corp.
   f. U.S. Pipe & Foundry Co.

g. Waterous Co.

6. Water Meters:

a. Sensus Technologies, Inc., BTR Co., or Baltimore County approved equal.

7. Detector-Type Water Meters:

a. Sensus Technologies, Inc., or Baltimore County approved equal.

8. Drains:

a. Ancon, Inc.
b. Jones Manufacturing Co., Inc.
c. Josam Co.
d. Jay R. Smith Mfg. Co. Div., Smith Industries, Inc.
e. Wade Div., Tyler Pipe Subsid., Tyler Corp.
f. Zurn Hydromechanics Div., Zurn Industries, Inc.

9. Detector Check Valves:

a. Ames Co., Inc.
b. Hersey Products, Inc., Grinnell Corp.
c. Kennedy Valve Div., McWane, Inc.
d. Viking Corp.
e. Watts Regulator Co.

10. Backflow Preventers:

a. Ames Co., Inc.
b. Cla-Val Co. Div., Griswold Industries.
c. Conbraco Industries, Inc.
d. Febco.
e. Hersey Products, Inc., Grinnell Corp.
f. Watts Regulator Co.
g. Wilkins Regulator Div., Zurn Industries, Inc.

2.2 PIPES AND TUBES

A. Refer to Part 3 Article "Piping Applications" for identification of systems where pipe and tube materials specified below are used.

B. Ductile-Iron Pipe: AWWA C151, Classes 150, 200, and 250.

1. Lining: AWWA C104, cement mortar, seal coated.
2. Gaskets, Glands, and Bolts and Nuts: AWWA C111.
3. Mechanical-Joint-Type Pipe: AWWA C111, rubber gaskets, ductile retain- or glands, and steel bolts and nuts.
4. Encasement: AWWA C105, polyethylene film tube.

C. Copper Tube: ASTM B 88, Types K and L (ASTM B 88M, Types A and B), seamless water tube, annealed temper.

2.3 PIPE AND TUBE FITTINGS

A. Refer to Part 3 Article "Piping Applications" for identification of systems where pipe and tube fitting materials specified below are used.

B. Ductile-Iron Pipe Fittings: AWWA C110, ductile-iron, 250-psig (1725-kPa) minimum pressure rating; or AWWA C153, ductile-iron compact fittings, 350-psig (2400-kPa) pressure rating.

1. Lining: AWWA C104, cement mortar.
2. Gaskets: AWWA C111, rubber.

C. Polyethylene Encasement: AWWA C105, 8-mils (2 mm) minimum thickness, tube or sheet.

2.4 JOINING MATERIALS

A. Refer to Part 3 Article "Piping Applications" for identification of systems where joining materials specified below are used.

B. Ductile-Iron Pipe and Ductile-Iron Fittings: The following materials apply:

1. Mechanical Joints: AWWA C111 ductile-iron retainer glands, high-strength steel bolts and nuts, and rubber gaskets.

2.5 PIPING SPECIALTIES

A. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 150-psig (1035-kPa) or 300-psig (2070-kPa) minimum pressure to suit system pressures.

B. Dielectric-Flange Insulation Kits: Field-assembled companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Provide separate companion flanges and steel bolts and nuts for 150-psig (1035-kPa) or 300-psig (2070-kPa) minimum working pressure to suit system pressures.

2.6 VALVES

A. Nonrising Stem Gate Valves 3 Inches (DN 80) and Larger: AWWA C500, cast-iron double disc, bronze disc and seat rings, bronze stem, cast-iron or ductile-iron body and bonnet, stem nut, 200-psig (1380-kPa) working pressure, mechanical joint ends.

B. Nonrising Stem Gate Valves 4 Inches (DN 100) and Larger: UL 262, FM approved, iron body and bonnet with flange for indicator post, bronze seating material, inside screw, 175-psig (1200-kPa) working pressure, mechanical joint ends. Provide with flanged ends for pit installation.

C. Valve Boxes: Cast-iron box having top section and cover with lettering "WATER," bottom section with base of size to fit over valve and barrel approximately 5 inches (124 mm) in diameter, and adjustable cast-iron extension of length required for depth of bury of valve.

1. Provide a steel tee-handle operating wrench with each valve box. Wrench shall have tee handle with one pointed end, stem of length to operate valve, and socket-fitting valve-operating nut.

D. Tapping Sleeve and Tapping Valve: Complete assembly, including tapping sleeve, tapping valve, and bolts and nuts. Use sleeve and valve compatible with tapping machine.

1. Tapping Sleeve: Cast-iron or ductile-iron 2-piece bolted sleeve with flanged outlet for new branch connection. Sleeve may have mechanical joint ends with rubber gaskets or sealing rings in sleeve body. Use sleeve that mates with size and type pipe material being tapped. Outlet flange shall be size required for branch connection.

E. Service Clamps and Corporation Stops: Complete assembly, including service clamp, corporation stop, and bolts and nuts. Use service clamp and stop compatible with drilling machine.

1. Service Clamp: Cast iron or ductile iron with gasket and AWWA C800 threaded outlet for corporation stop, and threaded end straps.
2. Corporation Stops: Bronze body and ground key plug, with AWWA C800 threaded inlet and outlet matching service piping material.
3. Manifold: Copper with 2 to 4 inlets as required, with ends matching corporation stops and outlet matching service piping.

2.7 WATER METERS

A. General: Provide water meter with registration in gallons.

B. Domestic Water Meter: As approved by Baltimore City.

C. Fire Service Water Meter: As approved by Baltimore City

2.8 PITS

A. Concrete: Portland cement mix, 3000 psi (20.7 MPa).

1. Cement: ASTM C 150, Type I.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Reinforcement: Steel conforming to the following:

1. Fabric: ASTM A 185, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615, Grade 60 (ASTM A 615, Grade 400), deformed.
3. Ladder: ASTM A 36 (ASTM A 36M), steel or polyethylene-encased steel steps.
4. Manhole: ASTM A 48, Class 35, gray-iron, 24-inch (610-mm) minimum diameter traffic frame and cover, of size and weight indicated.
5. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron, 24-inch (610-mm) minimum diameter traffic frame and cover, of size and weight indicated.
6. Drain: ASME A112.21.1M, cast-iron area drain, of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

2.9 FIRE HYDRANTS

A. General: Cast-iron body, compression-type valve, opening against pressure and closing with pressure, 6-inch (DN 150) mechanical joint inlet, 150-psig (1035-kPa) working pressure.

B. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.

C. Operating and Cap Nuts: Pentagon 12 inch (40 mm) point to flat.

D. Direction of Opening: Open hydrant valve by turning operating nut to the left, or counterclockwise.

E. Finish: The outside of all fire hydrants above the breakaway flange shall be factory painted with two coats of safety yellow industrial enamel paint B54 Y27 (Lead Free) as manufactured by Sherwin Williams, or approved equal.

F. Dry-Barrel Fire Hydrants: UL 246, FM-approved, two 22-inch (DN 65) and one 42-inch (DN 115) outlets, 53-inch (133 mm) main valve, drain valve, and 6-inch (DN 150) mechanical joint inlet.

2.10 ANCHORAGES AND BUTTRESSES

A. General: All anchorages and buttresses shall be in conformance with the Baltimore County Specifications and Standard Detail.

B. Concrete Reaction Backing: Portland cement mix, 3000 psi.

1. Cement: ASTM C 150, Type I.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable

2.11 IDENTIFICATION

A. Metallic-Lined Plastic Underground Warning Tapes: polyethylene plastic tape with metallic core, 6 inches wide, by 4 mils thick, solid blue in color with continuously printed caption in black letters “CAUTION - WATER LINE BURIED BELOW.”

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section 312300.

3.2 SERVICE ENTRANCE PIPING

A. Extend water system piping and building water distribution and fire protection systems 5' (five feet) from the face of the building wall in locations and pipe sizes indicated.

1. Terminate water system piping 5' (five feet) from the face of the building wall until building water systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building water systems when those systems are installed.

B. Water distribution systems and fire protection systems are specified in Division 15 Sections. Sleeves and mechanical sleeve seals are specified in Division 15 Section “Basic Mechanical Materials and Methods.”

3.3 PIPING APPLICATIONS

A. Refer to Part 2 of this Section for detailed specifications for pipe and fittings products listed below.

Use pipe, tube, fittings, and joining methods according to the following applications. Piping in pits and inside building may be joined with flanges or couplings, instead of joints indicated, for grooved-end AWWA-size piping.

B. Use pipe, tube, fittings, and joining methods according to following applications:

1. 22 inches (DN 65) to 32 inches (DN 90): Schedule 80 polyvinyl chloride (PVC) plastic pipe, Schedule 80 PVC fittings, and solvent-cemented joints.
2. 4 inches (DN 100) to 8 inches (DN 200): Class 250, ductile-iron pipe, ductile-iron compact fittings, and mechanical joints with retainer glands.

3.4 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Buried Valves 3 inches (DN 80) and Larger: AWWA, gate valves, nonrising stem, with valve box.

3.5 JOINT CONSTRUCTION

A. Ductile-Iron Piping Gasketed Joints: Construct joints according to AWWA C600.

B. Flanged Joints: Align flanges and install gaskets. Assemble joints by sequencing bolt tightening. Use lubricant on bolt threads.

C. Threaded Joints: Thread pipes with tapered pipe threads according to ASME B1.20.1, apply tape or joint compound, and apply wrench to valve ends into which pipes are being threaded.

D. AWWA Polyvinyl Chloride (PVC) Piping Gasketed Joints: Use AWWA C900 joining materials. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer’s written instructions.

E. Polyvinyl Chloride (PVC) Piping Solvent-Cement Joints: Construct joints according to ASTM D 2672 and ASTM D 2855.

1. Handling of Solvent Cements, Primers and Cleaners: Comply with procedures in ASTM F 402 for safe handling when joining plastic pipe and fittings with solvent cements.

F. Dissimilar Materials Piping Joints: Construct joints using adapters that are compatible with both piping materials, outside diameters, and system working pressure. Refer to “Piping Systems - Common Requirements” Article for joining piping of dissimilar metals.

3.6 PIPING SYSTEMS - COMMON REQUIREMENTS:

A. Installation: Installation shall be in accordance with the Baltimore County Specification Category 300 and the written recommendations of the pipe manufacturer, except that in the case where there are conflicts among the provision of the various installation requirements, the more stringent or restrictive requirements shall govern.

B. General Locations and Arrangements: Drawings indicate general locations and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated except where deviations to layout are approved on coordination drawings.

C. Install components having pressure rating equal to or greater than system rated pressure (280 psig).

D. Install piping free of sags and bends.

E. Install fittings for changes in direction.

F. Piping Connections: Except as otherwise indicated, making piping connections as specified below.

1. Install flanges, in piping 22 inches and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.

3.7 PIPING INSTALLATION

A. Comply with requirements of Baltimore County Specification Category 300 for materials and installation.

1. Bury piping at minimum depth of 48 inches below finished grade, and not less than 18 inches below average local frost depth.

3.8 ANCHORAGE INSTALLATION:

A. Anchorages: Install anchorages for tees, plugs/caps, and bends. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron Piping: According to AWWA C600.
2. Gasketed-Joint, Polyvinyl Chloride (PVC) Piping: According to AWWA M23.
3. Fire Service Piping: According to NFPA 24.

B. Apply full coat of asphalt or other acceptable corrosion-retarding to surfaces of installed ferrous anchorage devices.

C. Anchorage blocks shall be constructed of a poured reinforced concrete pad, which partially encapsulates the fitting and prevents any relative movement between the straight section of the fitting and the branch section.

3.9 IDENTIFICATION INSTALLATION

A. Install continuous plastic underground warning tape during back-filling of trench for underground water service piping. Locate 6 inches to 8 inches below finished grade, directly over piping.

3.10 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours prior to testing and apply test pressure to stabilize system. Use only potable water. Notify Owner 24 hours in advance for any tests.

B. Hydrostatic Tests: Test at not less than 2 times operating pressure for 2 hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test

pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 1000 joints. Remake leaking joints with new materials and repeat test until leakage is within above limits.

3.11 CLEANING

A. Clean and disinfect water distribution piping as follows:

1. Purge new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.
2. Use purging and disinfecting procedures prescribed by Baltimore County Specifications, Category 300.

B Prepare reports for purging and disinfecting activities.

END OF SECTION

SECTION 33 30 00 - SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

C. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition. Alternate methods and/or materials may be submitted to the Architect for consideration. Those judged to be equal to that specified will receive written approval.

D. Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials, dated July, 2023 and as amended.

1.2 SUMMARY

A. This Section includes sewage disposal systems.

B. Related Sections:

1. Section 017700: Closeout Procedures
2. Section 033000: Cast-In-Place Concrete
3. Section 312000; Earth Moving

1.3 DEFINITIONS

A. Wastewater: Sewage, water or other liquid requiring disposal.

1.4 PERFORMANCE REQUIREMENTS

A. The Contractor will be responsible for securing all appropriate utility permits, including but not limited to an on-site sewer permit.

B. Solid Piping Rating: At least equal to system operating pressure.

1.5 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Shop drawings for the following precast, reinforced-concrete structures, including manhole openings, covers, pipe connections, and accessories.

C. Coordination drawings showing piping, underground structures, and other utilities. Indicate size and invert elevations of piping and structures.

D. Record drawings at project closeout of installed sanitary sewer system piping and products

according to Division 1 Section “Closeout Procedures”, and “Project Record Documents”.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with provisions of the local health department and authorities having jurisdiction.

B. In the event of a discrepancy between the Project Specifications, Construction Documents, Baltimore County Standard Specifications and Details, or other guidelines set forth by the authorities having jurisdiction, the more stringent will apply.

C. Cast iron fittings and ductile iron pipe (DIP) and fittings shall be sound and without defects that might impair its service. Defective areas shall not exceed the maximum allowable minus wall thickness tolerance specified in AWWA C110 or C151. Repair of defects by welding or other methods will not be allowed. Defective or damaged lining areas may be repaired by cutting out the defective or damaged lining to the metal so that the edges of the lining not removed are perpendicular or slightly undercut. The cutout area and the adjoining lining shall be thoroughly wetted, and a stiff mortar applied and troweled smooth with the adjoining lining. After any surface water has evaporated, but while the patch is still moist, it shall be cured by the application of a seal coat.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe or fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle pre-cast concrete structures according to manufacturers rigging instructions.

1.8 PROJECT CONDITIONS

A. Site Information Data in subsurface investigation reports was used for the basis of the design. The data in the subsurface investigation report is not a part of the Contract. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. The Owner, Architect or Engineers will not be responsible for interpretations or conclusions drawn from this data by the Contractor.

1. Additional test borings and other exploratory operations may be performed by the Contractor, at the Contractor’s option; however, no change in the Contract Sum will be authorized for such additional exploration.

B. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Architect and then only after acceptable temporary utility services have been provided. If existing utilities are indicated to be abandoned, the Contractor shall remove such utility, if necessary, at no additional cost to the Owner.

1. Provide a minimum 48-hours’ notice to the Architect and receive written notice to proceed before interrupting any utility.

PART 2 - PRODUCTS

2.1 PIPES AND FITTINGS

A. Refer to Part 3 “Piping Applications” Article for identification of systems where piping materials specified below are used.

B. Polyvinyl Chloride (PVC) Sewer Pipe and Fittings: ASTM D 3034, SDR 26, nonperforated, for solvent-cement or elastomeric gasket joints.

1. Solvent Cement: ASTM D 2564.
2. Gaskets: ASTM F 477, elastomeric seal.

C. Ductile Iron Pipe and fittings

1. Pipe

a) Pipe shall be manufactured in accordance with the requirements of AWWA C151 except that the metal thickness shall be as described herein. Pipe nominal lengths may be 16 through 20 feet.
b) All pipe and fittings shall be designed and constructed to withstand all external pressure caused by overburden as indicated on the profile and traffic loads to which the pipe may be subjected.
c) Ductile iron pipe and ductile iron and cast iron fittings shall be cement-lined in accordance with AWWA C 104, double thickness. This lining shall be sealed with a bituminous seal coat. The outside surfaces shall be bituminous coated.

2. Joints

a) Joints may be mechanical or rubber gasketed push-on type. Unless otherwise noted, all joints shall be in accordance with AWWA C111.

3. Fittings

a) All fittings shall be manufactured in accordance with AWWA C110 or AWWA C 153 for compact fittings sizes 3 inch through 16 inch. Fittings shall be designed and constructed to withstand a pressure not less than that for the adjacent pipe.

4. Lining and Coating

a) All pipe and fittings shall be cement-lined in accordance with AWWA C104, double thickness. This lining shall be sealed with a bituminous seal coat. The outside surface shall be bituminous coated.

D. Sleeve-Type Couplings: Rubber or elastomeric sleeve and band assembly fabricated to match outside diameters of pipes to be joined.

1. Sleeves for Plastic Pipe: ASTM F 477, elastomeric seal.
2. Bands: Stainless steel, at least one at each pipe insert.

F. Gasket-Type Couplings: Rubber or elastomeric compression gasket, made to match outside diameter of smaller pipe and inside diameter or hub or adjoining larger pipe.

1. Gaskets for Plastic Pipe: ASTM F 477, elastomeric seal.
2. Gaskets for Dissimilar Pipes: Compatible with pipe materials being joined.

2.2 CLEANOUTS

A. Description: ASME A112.36.2M, with round, flanged, cast-iron housing, and secured scoriated, medium-dry loading class, cast-iron cover. Include cast-iron ferrule and countersunk brass cleanout

plug.

2.3 MANHOLES

A. Precast Concrete Manholes: ASTM C 478, precast reinforce concrete, of depth indicated, with provision for rubber gasket joints, and frame and cover; all in accordance with Baltimore County Standard Details. Include indented top design with lettering, equivalent to the following cast into cover:

1. Sanitary Sewer Piping Systems: BALTIMORE COUNTY SANITARY SEWER

2.4 PROTECTIVE COATINGS

A. General: Include factory or field-applied protective coatings to structures and appurtenances according to the following:

1. In accordance with the Baltimore County Department of Public Works Specifications for Sanitary Sewer Manholes.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section 312000.

3.2 IDENTIFICATION

A. Identification materials and their installation are specified in Division 2 Section “Excavating and Filling”. Arrange for installation of green warning tapes directly over piping (including absorption field piping), at outside edges of underground structures, and at outside edges of seepage pits.

1. Use detectable warning tape over edges of underground structures, edges of seepage pits, and over nonferrous piping.

3.3 GENERAL INSTALLATION

A. Installation: Installation shall be in accordance with the requirements of the Baltimore County Specifications, and in accordance with the Drawings.

B. Where installation details are not shown on the Drawings, installation shall be in accordance with the Baltimore County Standard Details.

C. Termination: Terminate piping 5' from building foundation in location as indicated. Provide temporary pipe plug for piping extension into building by work of Division 22.

3.4 PIPING APPLICATIONS

A. Use pipes, fittings, and joining methods, for all piping sizes, according to the following applications.

3.5 PIPE JOINT CONSTRUCTION AND INSTALLATION

A Join and install polyvinyl chloride (PVC) pipe as follows:

1. Join solvent-cement type pipe and fitting with solvent cement according to ASTM D 2855 and ASTM F402.

2. Join gasketed pipe and fittings with elastromeric seals according to ASTM D 3212.
3. Install solid piping according to ASTM D 2321.

3.6 CLEANOUT INSTALLATION

A. Install cleanouts and extension for mapping to cleanout at grade as indicated. Set cleanout housing and cover in concrete block 18 by 18 by 12 inches deep, except where location is in concrete paving. Set top of cleanout 1 inch above surrounding earth grade, or flush with grade when installed in paving.

B. Cleanout installed in paving shall have countersunk lid.

C. Refer to Division 3 Section “Cast-in-Place Concrete” for formwork, reinforcing and concrete.

3.7 CONNECTIONS

A. Install standard manhole over existing sanitary sewer and connect proposed sanitary.

3.8 FIELD QUALITY CONTROL

A. System Tests: After installation, pipe shall be inspected visually for deflections and misaligned pipe sections.

1. All sewers shall be tested in accordance with Section 361 of the Baltimore County Specifications, except that Contractor shall supply all materials needed for testing.
2. All sewers shall be air tested in accordance with Baltimore County requirements, except that Contractor shall supply all materials needed for testing.
3. Additional Tests: Fill underground structures with water and let stand overnight. If water level recedes, locate and repair leaks and retest. Repeat tests and repair until there is no leakage.
4. Cleaning: Clear interior of piping and structures of dirt and other superfluous materials as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.

END OF SECTION

SECTION 33 40 00 - STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

B. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number to establish standards of quality and performance and not for the purpose of limiting competition. Alternate methods and/or materials may be submitted to the Architect for consideration. Those judged to be equal to that specified will receive written approval.

C. Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials, dated July, 2023 and as amended.

1.2 SUMMARY

A. This Section includes drainage systems outside the building. Systems include the following:

1. Storm drainage
2. Stormwater Management Facility

B. Related Sections:

1. Section 017700: Closeout Procedures
2. Section 312000: Earth Moving
3. Refer to sections relating to plumbing piping, drainage and vent systems and laboratory systems in Division 22.

1.3 DEFINITIONS

A. Drainage Piping: System of sewer pipe, fittings, and appurtenances for gravity flow of storm drainage.

1.4 PERFORMANCE REQUIREMENTS:

A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

B. Stormwater Management Permit: Stormwater management facilities shall be constructed in accordance with the approved drawings and the provisions of the Stormwater Management Permit.

C. Certification of Completed Facilities: As-Built and Certifications are required for this stormwater management facility. In order to properly prepare these documents, the stormwater management facility must be inspected by a Registered Professional Engineer at specific stages of the construction. The Contractor shall notify the Certifying Engineer and Owner at least five (5) working days prior to starting work on this stormwater management facility. The Contractor shall also contact the Certifying engineer at least two (2) working days prior for each required inspection item shown on the contract documents. Preparation and processing of the

As-Built Plans and Certification will be the responsibility of the Contractor.

1.5 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for the following:

1. Cleanouts.
2. Piping.
3. Fittings.

C. Shop drawings for precast concrete manholes and other structures. Include frames, covers and grates.

D. Shop drawings for cast-in-place concrete or field-erected masonry manholes and other structures. Include frames, covers and grates.

E. Reports and calculations for design mixes for each class of cast-in-place concrete.

F. Inspection and test reports specified in the “Field Quality Control” Article.

G. Record drawings at Project closeout of installed storm drain system piping and products according to Division 1 Section “Closeout Procedures”, and “Project Record Documents”.

1.6 QUALITY ASSURANCE

A. Environmental Agency Compliance: Comply with regulations pertaining to sanitary sewerage and storm drainage systems.

B. Utility Compliance: Comply with regulations pertaining to sanitary sewerage and storm drainage systems. Include standards of water and other utilities where appropriate.

C. Product Options: Drawings indicate sizes, profiles, connections, and dimensional requirements of system components and are based on specific manufacturer types indicated. Other manufacturer’s products with equal performance characteristics may be considered.

D. In the event of a discrepancy between the Project Specifications, Construction Documents, Baltimore County requirements, or other guidelines set forth by the authorities having jurisdiction the more stringent will apply.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures in direct sunlight.

B. Do not store plastic pipe or fittings in direct sunlight.

C. Protect pipe, pipe fittings, and seals from dirt and damage.

D. Handle precast concrete manholes and other structures according to manufacturer’s rigging instructions.

1.8 PROJECT CONDITIONS

A. Site Information: Data in subsurface investigation reports was used for the basis of the design. The data in the subsurface investigation report is not a part of the Contract. Conditions are not intended as presentations or warranties of accuracy or continuity between soil borings. The Owner, Architect or Engineers will not be responsible for interpretations or conclusions drawn from this data by the Contractor.

1. Additional test borings and other exploratory operations may be performed by the Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.

B. Locate existing structures and piping to be closed and abandoned.

C. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted under the following conditions and then only after arranging to provide acceptable temporary utility services.

1. Notify Architect not less than 48 hours in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without receiving Architect's written permission.

D. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

1.9 SEQUENCING AND SCHEDULING

A. Coordinate with interior building drainage systems.

B. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cleanouts

a. Ancon, Inc.
b. Jones Manufacturing Co., Inc.
c. Josam Co.
d. Rockford Sanitary Systems, Inc.
e. Jay R. Smith Mfg. Co. Div., Smith Industries, Inc.
f. Wade Div., Tyler Corp.
g. Zurn Industries, Inc., Hydromechanics Div.

2. High Density Polyethylene (HDPE) pipe and fittings

a. Hancor
b. Advance Drainage Systems (ADS)
c. Lane Enterprises
d. JM Eagle

2.2 PIPES AND FITTINGS

A. Polyvinyl Chloride Schedule 40 (P.V.C. SCH40)(watertight).

B. Polyvinyl Chloride SDR 26 (P.V.C. SDR26)(watertight)

C. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, Class IV, Wall B, for gasketed joints.

1. Gaskets: ASTM C 443, rubber.

D. High Density Polyethylene (HDPE) pipe and fittings. Watertight Joint

2.3 SPECIAL PIPE COUPLINGS AND FITTINGS

A. Sleeve-Type Pipe Couplings: Rubber or elastomeric sleeve and band assembly fabricated to match outside diameters of pipes to be joined, for nonpressure joints.

1. Sleeves for Concrete Pipe: ASTM C 443 (ASTM C 443M), rubber.
2. Sleeves for Plastic Pipe: ASTM F 477, elastomeric seal.
3. Sleeves for Dissimilar Pipes: Compatible with pipe materials being joined.
4. Bands: Stainless steel, at least one at each pipe insert.

2.4 MANHOLES

A. Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for rubber gasket joints, and frame and cover, all in accordance with Baltimore County Standard Details. Include indented top design with lettering, equivalent to the following, cast into cover:

1. Storm Drainage Piping Systems: BALTIMORE COUNTY STORM DRAIN.

2.5 STORM DRAIN INLETS

A. General: Pre-cast reinforced concrete, or cast-in-place concrete complete with frames and grates, all in accordance with Baltimore County Standard Details or as otherwise noted on the plans.

2.6 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Structures: Portland-cement design mix, 4000 psi minimum, with 0.45 maximum water-cement ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615, Grade 60, deformed steel.

C. Structure Channels and Benches: Factory or held formed from concrete. Portland-cement design mix, 4000 psi minimum, with 0.45 maximum water-cement ratio.

1. Include channels and benches in manholes.

a. Manholes Channels: Concrete invert, formed to same width as connected piping,

with height of the vertical sides to 3/4 of the pipe diameter. Form curved channels with smooth, uniform radius and slope.

(1) Invert Slope: 2.5 percent (1:40) through manhole.
(2) Manhole Benches: Concrete, sloped to drain into channel.

(a) Slope: 1 inch per foot (1:12).

b. Include channels and benches in storm drain inlets.

(1) Storm Drain Inlet Channels: Concrete invert, formed to same width as connected piping, with height of the vertical sides to 3/4 of the pipe diameter. Form curved channels with smooth, uniform radius and slope.

(a) Invert Slope: 2.5 percent (1:40) through inlet.

(2) Storm Drain Inlet Benches: Concrete, sloped to drain into channel.

(b) Slope: 1 inch per foot (1:12).

2. Ballast and Pipe Supports: Portland-cement design mix, 3000 psi minimum, with 0.58 maximum water-cement ratio.

a. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
b. Reinforcement Bars: ASTM A 615, Grade 60, deformed steel.

2.7 PROTECTIVE COATINGS

A. General: Include factory - or field-applied protective coatings to structures and appurtenances according to the following:

1. In accordance with the Baltimore County Department of Public Works Specifications for Storm Drain Manholes.

2. Coating: Apply 2-coats, coal-tar epoxy, 15-mil minimum thickness, except where otherwise indicated.

a. Manholes: On exterior surfaces.
b. Storm Drain Inlets: On exterior surfaces.

2.8 CLEANOUTS

A. Description: ASME A112.36.2M, round, cast-iron housing with clamping device and found, secured, scoriated, cast-iron cover. Include cast-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug. Use units with top-loading classifications according to the following applications:

1. Light Duty: In earth or grass, foot-traffic areas.
2. Medium Duty: In paved, foot-traffic areas.
3. Heavy Duty: In vehicle-traffic service areas.2.9 RIPRAP

A. Stone for riprap shall be uniformly graded from the smallest to the largest pieces as specified in the Contract Documents. The stone will be accepted upon visual inspection at the point of usage, and shall conform to the following:

CLASS OF RIPRAP	WEIGHT RANGES lb (kg)	APPROX. SIZE in. (mm)
0	1-33 (0.5 – 15)	2-7 (50-175)
I	2-150 (1-70)	3-12 (75-300)
II	20-700 (10-320)	6-20 (150-500)
III	40-2000 (20-910)	8-28 (200-700)

2.9 GEOTEXTILES

A. Geotextiles shall conform to the class specified in the Contract Documents. The geotextile shall be manufactured from fibers consisting of long chain synthetic polymers, composed of a minimum 85 percent by weight of polyolephins, polyesters or polyamides. The geotextile shall resist deterioration from ultraviolet exposure. Geotextiles used in the construction of silt fence shall contain sufficient amounts of ultraviolet ray inhibitors and stabilizers to provide a minimum of 12 months of expected usable construction life at a temperature range of 0 to 120F (-18 to 49 C).

B. All values specified are minimum or maximum roll values.

C. Classes A through E Geotextiles shall have a 0.010 cm/sec minimum permeability when tested in conformance with D4491, and an apparent minimum elongation of 20 percent when tested for conformance with the grab tensile strength requirements specified below. Classes A through E Geotextiles shall also conform to the following additional requirements:

GEOTEXTILE CLASS	MAXIMUM APPARENT OPENING SIZE mm	GRAB TENSILE STRENGTH lb (N) min	MINIMUM BURST STRENGTH psi (MPa)
A	0.30	250 (1110)	500 (3.4)
B	0.60	200 (890)	320 (2.2)
C	0.30	200 (890)	320 (2.2)
D	0.60	90 (400)	145 (1.0)
E	0.30	90 (400)	145 (1.0)

D. Class F Geotextiles (Silt Fence) shall have a 50 lb/in. (8.8kN/m) minimum tensile strength and a 20 lb/in. (3.5kN/m) minimum tensile modulus when tested in conformance with D4595. The material shall also have a 0.3 gal/ft² (12.21/m²) per minute minimum flow rate and a 75 percent minimum filtering efficiency when tested in conformance with D 5141.

E. The properties shall be determined as follows:

TEST	METHOD
Apparent Opening Size	D 4751
Grab Tensile Strength	D 4632, Grab Test – 4 x 8 in. (100 x 200 mm) specimen, 1 x 2 in. (25 x 50 mm) clamps; 12 in. (300 mm)/minute strain rate both principal directions of geotextile.
Burst Strength	D 3786

Sewing of the geotextile will be allowed provided it conforms to the following:

a) Seams shall be either “J” or “butterfly” type and shall utilize a lock stitch.
b) Seams shall conform to the tensile strength requirements for the geotextile when tested across the seam.
c) The thread for seaming shall be of equal or greater durability than the geotextile itself.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 31 20 00 “Earth Moving.”

3.2 IDENTIFICATION

A. Materials and their installation are specified in Section 31 20 00. Arrange for installation of green detectable warning tapes directly over piping and at outside edges of underground structures.

3.3 PIPING APPLICATIONS

A. General: Include watertight, silttight, or soiltight joints, except where watertight or silttight joints are indicated.

B. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to the following applications.

C. High Density Polyethylene Pipe (HDPE), Hancor Blue Seal corrugated polyethylene pipe installed per manufacturers’ specifications.

D. Reinforced-concrete sewer pipe and fittings; rubber gaskets; and gasketed joints.

E. Polyvinyl Chloride (PVC) pipe: ASTM D 3034, PVC, solvent-cemented, sewer pipe fittings; and solvent-cemented joints.

3.4 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

A. Special Pipe Couplings: Use where indicated and where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.

1. Use the following pipe couplings for nonpressure applications:

a. Straight-pattern, sleeve type to join piping, of same size, with small difference in

outside diameters.

b. Increaser/reducer-pattern, sleeve type to join piping of different sizes.

c. Gasket type to join piping of different sizes where annular space between smaller piping's outside diameter and larger piping's inside diameter permits installation.

d. Internal-expansion type to join piping with same inside diameter.

B. Special Pipe Fittings: Use where indicated.

3.5 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of underground drainage systems piping. Location and arrangement of piping layout take into account many design considerations. Install piping as indicated, to extent practical and in accordance with the requirements of the Baltimore County Specifications and in accordance with the pipe manufacturer's written instructions. Where installation details are not shown on the Drawings, installation shall be in accordance with the Baltimore County Standard Details.

B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

C. Use manholes for changes in direction.

D. Use proper size increasers, reducers, and couplings, where different sizes or materials of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited, except as indicated on the plans.

E. Install piping at constant slope between points and elevations indicated. Install straight piping runs at constant slope, not less than that specified, where slope is not indicated.

F. Extend piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.

G. Install piping pitched down in direction of flow, at minimum slope of 1 percent (1:100) and 30-inch minimum cover, except where otherwise indicated.

3.6 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. General: Join and install pipe and fittings according to the following.

B. Polyvinyl Chloride Schedule 40 Pipe (P.V.C. SCH40) Pipe and Fittings: Join and install in accordance with manufacturer's instructions.

C. Concrete Pipe and Fittings: Install according to ACPA "Concrete Pipe Handbook." Use the following seals:

1. Round Pipe and Fittings: ASTM C 443 (ASTM C 443M), rubber gaskets.

D. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and fit both systems' materials and dimensions.

3.7 MANHOLE INSTALLATION

A. General: Install manholes, complete with accessories, as indicated.

B. Form continuous concrete channels and benches between inlets and outlet, where indicated.

C. Set tops of frames and covers flush with finished surface where manholes occur in pavements. Set tops 3 inches above finished surface elsewhere, except where otherwise indicated.

D. Place precast concrete manhole sections as indicated, and install according to ASTM C 891.

1. Provide rubber joint gasket complying with ASTM C 443, at joints of sections.
2. Apply bituminous mastic coating at joints of sections.

E. Construct cast-in-place manholes as indicated.

3.8 STORM DRAIN OUTFALL INSTALLATION

A. Install end sections as indicated.

B. Construct rip-rap of broken stone, as indicated.

3.9 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318, ACI 350R, and as indicated.

3.10 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in pipe.

B. Set cleanout frames and covers in concrete paving with tops flush with surface of paving.

C. Cleanouts located in paving shall have countersunk lids.

3.11 CLOSING ABANDONED DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping that is indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either of the following procedures:

1. Close open ends of piping with at least 8-inch-thick brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Structures: Excavate around structure as required and use either of the following procedures:

1. Remove structure and close open ends of remaining piping.
2. Remove top of structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
3. Backfill to grade according to Division 2 Section 312300 “Excavating and Filling.”

3.12 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as the work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.

1. In large, accessible piping, brushes and brooms may be used for cleaning.
2. Place plug in end of incomplete piping at end of day and whenever work stops.
3. Flush piping between manholes and other structures, if required by authorities having jurisdiction, to remove collected debris.

B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of the Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of a ball or cylinder of a size not less than 92.5 percent of piping diameter.
    c. Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedures until results are satisfactory.

C. Test new piping systems and parts of existing systems that have been altered, extended, or repaired for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests, and their inspections by authorities having jurisdiction, with at least 24 hours advance notice.
4. Submit separate reports for each test.
5. Where authorities having jurisdiction do not have published procedures, perform tests as follows:

    a. Storm Drainage: Perform hydrostatic test.

        (1) Allowable leakage is a maximum of 200 gallons per inch nominal pipe size, for every mile of pipe, during a 24-hour period.
        (2) Close openings in system and fill with water.
        (3) Purge air and refill with water.
        (4) Disconnect water supply.
        (5) Test and inspect joints for leaks.
        (6) Option: Test ductile-iron piping according to AWWA C600, Section 4 “Hydrostatic Testing.” Use test pressure of at least 5 psig.
        (7) Option: Test concrete piping according to ASTM C 969.
        (8) Option: Test concrete arch piping and elliptical piping according to authorities having jurisdiction.

    b. Storm Drainage: Perform hydrostatic test. Close openings in system and fill with water to not less than 10-foot head of water. Disconnect water supply. Water level must not drop for 15 minutes. Inspect joints for leaks.

        (1) Option: Test concrete arch piping and elliptical piping according to authorities having jurisdiction.

    c. Storm Drainage: Perform air test according to UNI-B-6.

(1) Option: Test round concrete piping, 24 inches and smaller, according to ASTM C 924.
(2) Option: Test concrete arch piping and elliptical piping according to authorities having jurisdiction.

6. Manholes: Perform hydraulic test according to ASTM C 969.
7. Leaks and loss in test pressure constitute defects that must be repaired.
8. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

END OF SECTION

SECTION 33 46 00 - SUBDRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Baltimore County Department of Public Works Standard Details for Construction dated February 2007 and as amended.

C. Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials, dated July, 2023 and as amended.

1.2 SUMMARY

A. Section Includes:

1. Perforated-wall pipe and fittings.
2. Drainage conduits.
3. Drainage panels.
4. Geotextile filter fabrics.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Drainage conduits, including rated capacities.
2. Drainage panels, including rated capacities.
3. Geotextile filter fabrics.

PART 2 - PRODUCTS

2.1 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated PE Pipe and Fittings:

1. NPS 6 (DN 150) and Smaller: ASTM F405 or AASHTO M 252, Type CP; corrugated, for coupled joints.
2. NPS 8 (DN 200) and Larger: ASTM F667; AASHTO M 252, Type CP; or AASHTO M 294, Type CP; corrugated; for coupled joints.
3. Couplings: Manufacturer's standard, band type.

B. Perforated PVC Sewer Pipe and Fittings: ASTM D2729, bell-and-spigot ends, for loose joints.

2.2 DRAINAGE CONDUITS

A. Molded-Sheet Drainage Conduits: Prefabricated geocomposite with cuspated, molded-plastic drainage core wrapped in geotextile filter fabric.

1. Nominal Size: 12 inches (304.8 mm) high by approximately 1 inch (25.4 mm) thick.

a. Minimum In-Plane Flow: 30 gpm (113.6 L/min.) at hydraulic gradient of 1.0 when tested according to ASTM D4716.

2. Filter Fabric: PP geotextile.
3. Fittings: HDPE with combination NPS 4 and NPS 6 (DN 100 and DN 150) outlet connection.

B. Single-Pipe Drainage Conduits: Prefabricated geocomposite with perforated corrugated core molded from HDPE complying with ASTM D3350 and wrapped in geotextile filter fabric.

1. Nominal Size: 12 inches (304.8 mm) high by approximately 1 inch (25.4 mm) thick.

a. Minimum In-Plane Flow: 30 gpm (113.6 L/min.) at hydraulic gradient of 1.0 when tested according to ASTM D4716.

2. Filter Fabric: PP geotextile.
3. Fittings: HDPE with combination NPS 4 and NPS 6 (DN 100 and DN 150) outlet connection.
4. Couplings: Corrugated HDPE band.

C. Mesh Fabric Drainage Conduits: Prefabricated geocomposite with plastic-filament drainage core wrapped in geotextile filter fabric. Include fittings for bends and connection to drainage piping.

1. Nominal Size: 6 inches (152.4 mm) high by approximately 0.9 inch (22.9 mm) thick.

a. Minimum In-Plane Flow: 2.4 gpm (9.1 L/min.) at hydraulic gradient of 1.0 when tested according to ASTM D4716.

2. Filter Fabric: Nonwoven geotextile made of PP or polyester fibers or combination of both. Flow rates range from 120 to 200 gpm/sq. ft. (81.5 to 135.8 L/s per sq. m) when tested according to ASTM D4491.

2.3 DRAINAGE PANELS

A. Molded-Sheet Drainage Panels: Prefabricated geocomposite, 36 to 60 inches (914.4 to 1524 mm) wide with drainage core faced with geotextile filter fabric.

1. Drainage Core: Three-dimensional, nonbiodegradable, molded PP.

a. Minimum Compressive Strength: 10,000 lbf/sq. ft. (478.8 kPa) when tested according to ASTM D1621.
b. Minimum In-Plane Flow Rate: 2.8 gpm/ft. (34.8 L/min. per m) of unit width at hydraulic gradient of 1.0 and compressive stress of 25 psig (172.4 kPa) when tested according to ASTM D4716.

2. Filter Fabric: Nonwoven needle-punched geotextile, manufactured for subsurface drainage, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with the following properties determined according to AASHTO M 288:

a. Survivability: Class 1.
b. Apparent Opening Size: No. 40 (0.425-mm) sieve, maximum.
c. Permittivity: 0.5 per second, minimum.

3. Film Backing: Polymeric film bonded to drainage core surface.

B. Mesh Fabric Drainage Panels: Prefabricated geocomposite with drainage core faced with geotextile filter fabric.

1. Drainage Core: Open-construction, resilient, plastic-filament mesh, approximately 0.4 inches (10.2 mm) thick.

a. Minimum In-Plane Flow Rate: 2.4 gpm/ft. (29.8 L/min. per m) of unit width at hydraulic gradient of 1.0 and normal pressure of 25 psig (172.4 kPa) when tested according to ASTM D4716.

2. Filter Fabric: Nonwoven geotextile of PP or polyester fibers or combination of both. Flow rates range from 120 to 200 gpm/sq. ft. (81.5 to 135.8 L/s per sq. m) when tested according to ASTM D4491.

2.4 SOIL MATERIALS

A. Soil materials are specified in Section 31 20 00 "Earth Moving."

2.5 GEOTEXTILE FILTER FABRICS

A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. (4488 to 13,446 L/min. per sq. m) when tested according to ASTM D4491.

B. Structure Type: Nonwoven, needle-punched continuous filament.

1. Survivability: AASHTO M 288 Class 2.
2. Styles: Flat and sock.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.

B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.

C. Verify that drainage panels installed as part of foundation wall waterproofing is properly positioned to drain into subdrainage system.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.3 FOUNDATION DRAINAGE INSTALLATION

A. Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed. Place and compact impervious fill to dimensions indicated, but not less than 6 inches (152.4 mm) deep and 12 inches (304.8 mm) wide.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches (101.6 mm).

D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.

E. Install drainage piping as indicated in Part 3 "Piping Installation" Article for foundation subdrainage.

F. Add drainage course to width of at least 6 inches (152.4 mm) on side away from wall and to top of pipe to perform tests.

G. After satisfactory testing, cover drainage piping to width of at least 6 inches (152.4 mm) on side away from footing and above top of pipe to within 12 inches (304.8 mm) of finish grade.

H. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.

I. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches (101.6 mm).

J. Install drainage panels on foundation walls as follows:

1. Coordinate placement with other drainage materials.
2. Lay perforated drainage pipe at base of footing. Install as indicated in Part 3 "Piping Installation" Article.
3. Separate 4 inches (101.6 mm) of fabric at beginning of roll and cut away 4 inches (101.6 mm) of core. Wrap fabric around end of remaining core.
4. Attach panels to wall beginning at subdrainage pipe. Place and secure molded-sheet drainage panels, with geotextile facing away from wall.

K. Place backfill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches (152.4 mm). Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

3.4 UNDERSLAB DRAINAGE INSTALLATION

A. Excavate for underslab drainage system after subgrade material has been compacted but before drainage course has been placed. Include horizontal distance of at least 6 inches (152.4 mm) between drainage pipe and trench walls. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches (101.6 mm).

D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.

E. Install drainage piping as indicated in Part 3 "Piping Installation" Article for underslab subdrainage.

F. Add drainage course to width of at least 6 inches (152.4 mm) on side away from wall and to top of pipe to perform tests.

G. After satisfactory testing, cover drainage piping with drainage course to elevation of bottom of slab, and compact and wrap top of drainage course with flat-style geotextile filter fabric.

H. Install horizontal drainage panels as follows:

1. Coordinate placement with other drainage materials.
2. Lay perforated drainage pipe at inside edge of footing.
3. Place drainage panel over drainage pipe with core side up. Peel back fabric and wrap fabric around pipe. Locate top of core at bottom elevation of floor slab.
4. Butt additional panels against other installed panels. If panels have plastic flanges, overlap installed panel with flange.

3.5 RETAINING-WALL DRAINAGE INSTALLATION

A. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

B. Place supporting layer of drainage course over compacted subgrade to compacted depth of not less than 4 inches (101.6 mm).

C. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.

D. Install drainage piping as indicated in Part 3 "Piping Installation" Article for retaining-wall subdrainage.

E. Add drainage course to width of at least 6 inches (152.4 mm) on side away from wall and to top of pipe to perform tests.

F. After satisfactory testing, cover drainage piping to width of at least 6 inches (152.4 mm) on side away from footing and above top of pipe to within 12 inches (304.8 mm) of finish grade.

G. Place drainage course in layers not exceeding 3 inches (76.2 mm) in loose depth; compact each layer placed and wrap top of drainage course with flat-style geotextile filter fabric.

H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches (101.6 mm).

I. Install drainage panels on wall as follows:

1. Coordinate placement with other drainage materials.
2. Lay perforated drainage pipe at base of footing as described elsewhere in this Specification. Do not install aggregate.
3. If weep holes are used instead of drainage pipe, cut ½ inch (12.7 mm) diameter holes on core side at weep-hole locations. Do not cut fabric.
4. Mark horizontal calk line on wall at a point 6 inches (152.4 mm) less than panel width above footing bottom. Before marking wall, subtract footing width.
5. Separate 4 inches (101.6 mm) of fabric at beginning of roll and cut away 4 inches (101.6 mm) of core. Wrap fabric around end of remaining core.
6. Attach panel to wall at horizontal mark and at beginning of wall corner. Place core side of panel against wall. Use concrete nails with washers through product. Place nails from 2 to 6 inches (50.8 to 152.4 mm) below top of panel, approximately 48 inches (1219.2 mm) apart. Construction adhesives, metal stick pins, or double-sided tape may be used instead of nails. Do not penetrate waterproofing. Before using adhesives, discuss with waterproofing manufacturer.
7. If another panel is required on same row, cut away 4 inches (101.6 mm) of installed panel core and wrap fabric over new panel.
8. If additional rows of panel are required, overlap lower panel with 4 inches (101.6 mm) of fabric.

9. Cut panel as necessary to keep top 12 inches (304.8 mm) below finish grade.
10. For inside corners, bend panel. For outside corners, cut core to provide 3 inches (76.2 mm) for overlap.

J. Fill to Grade: Place satisfactory soil fill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches (152.4 mm). Thoroughly compact each layer. Fill to finish grade.

3.6 LANDSCAPING DRAINAGE INSTALLATION

A. Provide trench width to allow installation of drainage conduit. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches (101.6 mm).

D. Install drainage conduits as indicated in Part 3 "Piping Installation" Article for landscaping subdrainage with horizontal distance of at least 6 inches (152.4 mm) between conduit and trench walls. Wrap drainage conduits without integral geotextile filter fabric with flat-style geotextile filter fabric before installation. Connect fabric sections with adhesive or tape.

E. Add drainage course to top of drainage conduits.

F. After satisfactory testing, cover drainage conduit to within 12 inches (304.8 mm) of finish grade.

G. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.

H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches (101.6 mm).

I. Fill to Grade: Place satisfactory soil fill material over drainage course. Place material in loose-depth layers not exceeding 6 inches (152.4 mm). Thoroughly compact each layer. Fill to finish grade.

3.7 PIPING INSTALLATION

A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.

1. Foundation Subdrainage: Install piping level and with a minimum cover of 36 inches (914.4 mm) unless otherwise indicated.
2. Underslab Subdrainage: Install piping level.
3. Retaining-Wall Subdrainage: When water discharges at end of wall into stormwater piping system, install piping level and with a minimum cover of 36 inches (914.4 mm) unless otherwise indicated.
4. Landscaping Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 36 inches (914.4 mm) unless otherwise indicated.
5. Lay perforated pipe with perforations down.

6. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.

B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

C. Install thermoplastic piping according to ASTM D2321.

3.8 PIPE JOINT CONSTRUCTION

A. Join perforated PE pipe and fittings with couplings according to ASTM D3212 with loose banded, coupled, or push-on joints.

B. Join perforated PVC sewer pipe and fittings according to ASTM D3212 with loose bell-and-spigot, push-on joints.

C. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.9 BACKWATER VALVE INSTALLATION

A. Comply with requirements for backwater valves specified in Section 33 41 00 "Storm Utility Drainage Piping."

B. Install horizontal backwater valves in header piping downstream from perforated subdrainage piping.

C. Install horizontal backwater valves in piping in manholes or pits where indicated.

3.10 CLEANOUT INSTALLATION

A. Comply with requirements for cleanouts specified in Section 33 41 00 "Storm Utility Drainage Piping."

B. Cleanouts for Retaining-Wall and Landscaping Subdrainage:

1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
2. In vehicular-traffic areas, use NPS 4 (DN 100) cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 18 by 18 by 12 inches (457.2 by 457.2 by 304.8 mm) deep. Set top of cleanout flush with grade.
3. In nonvehicular-traffic areas, use NPS 4 (DN 100) PVC pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 12 by 12 by 4 inches (304.8 by 304.8 by 101.6 mm) deep. Set top of cleanout 1 inch (25.4 mm) above grade.
4. Comply with requirements for concrete specified in Section 03 30 00 "Cast-in-Place Concrete."

C. Cleanouts for Underslab Subdrainage:

1. Install cleanouts and riser extensions from piping to top of slab. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
2. Use NPS 4 (DN 100) cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout flush with top of slab.

3.11 CONNECTIONS

A. Comply with requirements for piping specified in Section 33 41 00 "Storm Utility Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect low elevations of subdrainage system to solid-wall-piping storm drainage system.

3.12 IDENTIFICATION

A. Arrange for installation of green warning tapes directly over piping. Comply with requirements for underground warning tapes specified in specified in Section 31 20 00 "Earth Moving."

1. Install PE warning tape or detectable warning tape over ferrous piping.
2. Install detectable warning tape over nonferrous piping and over edges of underground structures.

3.13 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling.
2. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

B. Drain piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.14 CLEANING

A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION

Docusign Envelope ID: E963B607-690B-4E52-AD5A-70B4F50E1B3A

BGE Revenue Processing
5th Floor
PO Box 1475
Baltimore, MD 21203-1475

August 11, 2025
BGE W/O Job Number: 20086185

CHARLES JONES
12200 LONG GREEN PIKE
GLENN ARM, MD, 21057

BGE has prepared a detailed gas and electric installation design, including the specific plans needed for our construction crews to perform work at: 901 WALKER AVE.

BGE requires a minimum of 25 business days from completion of all customer requirements to start construction
BGE WILL NOT schedule the service and meter without reciept of the Certificate-of-Inspection from the local municipality

Step 1: To keep your project moving forward, use the enclosed envelope to return all items indicated below or send to the address above, or sign as indicated online via Sertifi.

☐ Signed Right of Way Agreement (Signed by the owner(s) and notarized as indicated.)

☑ Review and Sign the Final BGE Design Drawing.
This will serve as the approval for the location of BGE's facilities.

☑ Remaining Payment Due: $26,877.00
The amount above represents the balance of the customer contribution amount due. To ensure proper credit for payment, please note the BGE W/O Job Number & Job Address on your check and return with cut-off below. Please use the following account number 9748649085 for all billable construction charges on your work order.

The pricing is valid for 90 calendar days from the date of this contract and is subject to change after the 90 day period.

Step 2: Comply with the following agreed-upon site preparation for our equipment:

☑ Site to be within six inches of final grade.	☑ Install load cables and/or gas piping through the building wall Install CT cabinet or meter socket, if applicable
☑ Install and mark in 3' intervals: Water, Sewer, Telephone, Storm Drain, and other Non-BGE Utilities	☑ Install all road crossings
☑ Locate and clearly mark all private under-ground facilities on job site: Well Water Line, Septic Field, Private Lighting, Underground Sprinkler Systems, Invisible Fence Wires, Etc.	☑ Install conduits with pull strings per BGE specifications. Conduit will be min. 4" inside dimension IPS UL SCH 40. The customer will pull a mandrel through each duct prior to BGE cable installation, follwed by a pulling line which shall remain in each duct.
☑ Install soil erosion and sediment controls.	☑ Clear the site of all building materials, trees, stumps, and other obstructions along the route of the proposed BGE facilities
☑ Locate and clearly mark proposed property lines, curb & gutter on the job site.(if applicable) Important	☑ Install gas meter pads, transformer pads per BGE specifications
☑ Stake transformer/switchgear location.	☑ Review the available customer information booklets at BGE.com to assist with fulfilling your requirements. Contact your BGE representative with any questions

Once the site is ready, contact your BGE New Business Job Owner to schedule the job.

Upon receipt of the items indicated above, all applicable utility permits, and a certificate of approval from the jurisdictional authority, BGE will schedule construction of your job. To assist us in providing hassle-free customer service, have your BGE W/O Job Number available. The charge for this project is for BGE work only and does not include any other utilites. If the BGE pre-site inspection fails or any of the requirements are not satisfied in a timely manner the project may be delayed and pushed back in the schedule a minimum of 15 business days.

If you have any questions about this information, please contact me at 667-313-3361.

Sincerely,

Justin Cahill
New Business Job Owner
667-313-3361

Initial JC

For Job Status Information visit www.bge.com New Construction Services, Check Job Status

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BGE W/O Job Number: 20086185

Payment Due: $26,877.00

The amount above represents the balance of the customer contribution amount due. To ensure proper credit for payment, please note the BGE W/O Job Number & Job Address on your check.

Please use the following account number 9748649085 for all billable construction charges on your work order.

Mail payment to BGE Revenue Processing, 5th Floor PO Box 1475, Baltimore, MD 21203-1475

Docusign Envelope ID: E963B607-690B-4E52-AD5A-70B4F50E1B3A

EXTENSION/RELOCATION CONTRACT

Contract Job Number 20086185

Site Address: 901 WALKER AVE
City/State: BALTIMORE /MD
Zip: 21228

Development Name: 901 WALKER AVE, BALTIMORE, MD BALT

BGE Rep.: Justin Cahill

Customer Name: CHARLES JONES
Billing Address: 12200 LONG GREEN PIKE GLENN ARM , MD 21057

Segment A Description of Services: CONNECT MAIN, SVC OR MTR ELEC

Details: INSTALLATION OF ELECTRIC MAIN, SERVICE, AND METER FOR 901 WALKER AVE. REMOVAL / ABANDONMENT OF ELECTRIC MAIN, SERVICE, AND METER / GAS SERVICE AND METER FOR 901 WALKER AVE, BLDG 101 AND S 901 WALKER AVE.

Charge for A	$22,988.00
Tax*	$3,889.00
Gross Total A	$26,877.00

CIAC Project Id: BGENDC001

EA0000CMSM

Job Number: 20086185 Job Type: EA
Voltage Class: N/A KVA Demand: 0 Delivery Pressure: N/A Total CFH: 0

- [x] Option A - Payment in Full with Contract
- [ ] Option B - 10% Down & 90% Prior to Construction
- [ ] Option C - More then 10% Down & Balance Prior to Construction

1. Total Customer Charges (A&B)	$26,877.00
2. Payment with Contract	
3. Balance Due Prior to Construction	

Office Use Only:
PO No.
CIS. No.

*Explanation of Charge for "Tax": This charge represents a reimbursement for interest costs that BGE will incur as a result of Customer's payment under this Contract. This payment is taxable income to BGE under Subsection 824 of the Tax Reform Act of 1986 - Amendment to Section 118(b) of the Internal Revenue Code. BGE must pay federal and state income taxes on this payment in the tax year it is received. Additionally, the IRS requires BGE to capitalize and depreciate the project costs over 20 years. This results in an interest cost to BGE for paying out tax dollars in the current year which BGE will not fully recover until 20 years later. It is general utility industry practice to charge the gross-up amount to the customer who directly benefits from the work rather than burdening all utility customers through higher rates.

By signing below, Customer and BGE understand and accept all of the terms and conditions of this Contract, including, but not limited to, the General Terms and Conditions.

Signed by: Dave Earling D39C56FC2E26446...
X
Customer Signature — Date: 8/20/2025

Dave Earling
Print Name & Title (if applicable) Above

Baltimore County Property Management Senior Project Manager
Legal Name of Business (if applicable)

Signed by: Justin Cahill CE0EBD9C9C21478...
BGE Representative Signature — Contract Effective Date: 8/20/2025

Justin Cahill
Print Name and Title Above

Baltimore Gas and Electric Company

Revised: 01-23-2017

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Docusign Envelope ID: E963B607-690B-4E52-AD5A-70B4F50E1B3A

General Terms and Conditions

1. Parties. "BGE" mean Baltimore Gas and Electric Company, and "Customer" means the person or business identified on page 1 of this Extension/Relocation Contract (the "Contract"). BGE and Customer shall be referred to collectively as the "Parties" and individually as a "Party".
2. Contract Effective Date. The Contract shall not become effective until it has been duly executed by both Customer and BGE, after which the effective date of the Contract shall be as shown on page 1 of this Contract.
3. Request for Services. Customer has requested that BGE perform certain services, as described on page 1 of this Contract and any other pages attached to this Contract and/or incorporated by reference (the "Services").
4. Work Schedule. BGE shall perform the Services according to its own schedule and workforce requirements, which BGE shall determine in its sole discretion.
5. Estimated Completion Time. Any estimated completion time provided by BGE to Customer in connection with the performance of the Services is subject to modification or extension at BGE's sole discretion.
6. Payment for Construction. BGE shall perform the Services in consideration for Customer's payment of all costs and charges set forth in this Contract. If Customer fails to timely pay such costs and charges, BGE shall have the right to immediately terminate this Contract and exercise any of the rights and remedies set forth in this Contract and/or as otherwise provided by law.
7. Obligations of Customer Related to Performance of the Services. The term "Site" shall refer to the location at which BGE shall perform the Services, as described in this Contract and/or any agreed-upon construction or site plan drawings. BGE shall have no obligation to perform the Services until Customer has submitted payment(s) to BGE for all costs and charges set forth in this Contract and completed the following tasks and work at the sole cost of Customer:
   - Furnish all on-Site and off-Site easements required by BGE for the Services and to provide electric and/or gas service to Customer and to other customers and users of the Facilities, using BGE's standard forms or other forms acceptable to BGE.
   - Provide accurate Site plans, grading plans, utility plans, and any other plans requested by BGE related to the Site.
   - Locate and mark all private underground facilities at the Site and otherwise comply with the requirements of Title 12 of the Public Utilities Article of the Annotated Code of Maryland (commonly referred to as the "Miss Utility Law").
   - Clear the Site of all trees, stumps, and other obstructions.
   - Grade the Site to within six (6) inches of final grade.
   - Supply and install conduit, ducts, splice boxes, manholes, transformer pads, gas meter pads, switchgear tubs, and/or other facilities, as required by BGE to perform the Services and in accordance with applicable BGE construction standards.
   - Supply and install non-BGE utilities at the Site.
   - Locate and mark property and curb lines at the Site.
   - Perform any other work reasonably required by BGE to provide satisfactory conditions for performance of the Services at the Site and/or to assure compliance with BGE's electric and gas service tariffs and construction standards and any applicable laws, regulations, or permitting requirements.
8. Ownership of BGE-Installed Facilities. The facilities and equipment installed by BGE as part of the Services described in this Contract and any future repairs, replacements, upgrades, or adjustments thereof shall be collectively referred to in this Contract as the "BGE-Installed Facilities". With the sole exception of the "Customer Main Gas Valve", which is installed at the outlet of the gas meter set, the BGE-Installed Facilities shall remain the sole and exclusive property of BGE. The Customer Main Gas Valve shall become the property of the Customer after BGE completes installation and checks for leaks and proper operation.
9. Transfer of Title to Customer-Installed Facilities. Upon BGE's inspection and final acceptance of any conduits, ducts, splice boxes, manholes, transformer pads, gas meter pads, switchgear tubs, and/or other facilities related to the Services installed by Customer in connection with this Contract (collectively, the "Customer-Installed Facilities"), title to all such Customer-Installed Facilities shall automatically transfer to BGE free and clear of all liens, claims, and encumbrances and neither Customer nor any other party shall continue to maintain any interest in the Customer-Installed Facilities (or any parts or components thereof).
10. Confirmation of Title to the Facilities. The BGE-Installed Facilities and the Customer-Installed Facilities are collectively, the "Facilities". BGE may, in its sole discretion, affix to the Facilities (or any parts or components thereof) labels or other markings indicating BGE's ownership of the Facilities. Use by the Customer of the Facilities does not divest BGE of its exclusive rights to such ownership, use, and possession. The Customer shall, upon the request of BGE, execute and deliver to BGE all documents reasonably necessary or advisable to confirm, perfect, or evidence the rights of BGE in and to the Facilities.
11. BGE Right to Terminate. BGE has the right to immediately terminate this Contract for cause upon written notice to Customer. The following shall constitute cause for termination: (1) the failure of Customer to timely and properly perform any of its obligations set forth in this Contract to the satisfaction of BGE; and (2) the inability of BGE to commence the Services within ninety (90) calendar days of the Contract Effective Date as a result of the actions or inactions of Customer. In the event of such a termination for cause, BGE shall provide Customer a pro-rata refund of any amounts previously paid for Services that BGE did not perform as of the effective date of termination, less any additional administration or other costs incurred by BGE related to the termination for cause. BGE also has the right to terminate this Contract if performance of the Services or any obligation of BGE under this Contract would interfere or conflict with BGE's ability to satisfactorily comply with any duties, requirements, obligations, or responsibilities that may exist under applicable law, including, but not limited to, any rule, regulation, or decision issued by the Maryland Public Service Commission or any federal, state, or local government permitting authority. In the event of such a termination, BGE shall fully refund to Customer any amounts previously paid for the Services.
12. Customer Right to Terminate. Upon thirty (30) calendar days' prior written notice, Customer shall have the right to terminate this Contract, with or without cause. In the event of such a termination, BGE shall provide Customer a pro-rata refund of any amounts previously paid for Services that BGE did not perform as of the effective date of termination, less any additional administration or

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other costs incurred by BGE related to the termination or performance of the Services or Contract.

13. Customer Payment of Damages or Costs. Customer shall be required to pay BGE an amount equal to any damages or costs incurred by BGE related to the following:
    - The failure of Customer to perform any of its obligations under this Contract, including, but not limited to, the failure to provide BGE with a Site suitable for performance of the Services.
    - Any action or inaction of Customer that delays completion of the Services.
    - The failure of Customer (or another responsible party) to initiate the gas and/or electric service described in this Contract at the capacity and load requested within twelve (12) months of completion of the Services.
    - The failure of Customer (or another responsible party) to use the gas and/or electric service described in this Contract at the capacity and load requested for the term of contract of the applicable rate schedule, as described in BGE's electric and/or gas service tariffs.
    - A change in the location of the Site, conditions of the Site, or scope of work to be performed by BGE.
    - The failure of Customer to disclose all Site conditions related to performance of the Services.
14. Waiver of Jury Trial. BGE AND CUSTOMER KNOWINGLY, WILLINGLY, VOLUNTARILY, AND IRREVOCABLY WAIVE ANY RIGHT TO HAVE ANY CLAIM OR DISPUTE RELATED TO THIS CONTRACT HEARD BY A JURY. ANY SUCH CLAIMS OR DISPUTES, THEREFORE, WILL BE HEARD ONLY BY A JUDGE.
15. Limitation of Liability. In no event shall BGE or its officers, directors, employees, agents, representatives, affiliates, and assigns be liable for any special, indirect, incidental, exemplary, punitive, or consequential damages of any sort whatsoever, including, but not limited to, any delay damages or lost profits/revenues, arising out of or related, in whole or in part, to this Contract, regardless of whether the liability arises in tort or contract, at law or equity. Notwithstanding anything contained in this Contract to the contrary, in no event shall BGE's total liability resulting from or occurring in connection with its obligations or performance of any Services or other work under this Contract exceed the amount paid to BGE by Customer.
16. Indemnification. To the fullest extent permitted by law, Customer agrees to indemnify, hold harmless, and at Customer's sole cost defend BGE, its officers, directors, employees, agents, representatives, affiliates, and assigns from and against any and all claims, liabilities, damages, expenses, suits, or demands (including, but not limited to, reasonable attorneys' fees and expenses) arising out of or in any manner related to the acts, omissions, or responsibilities of Customer in connection with this Contract.
17. Force Majeure. BGE may at any time extend, suspend, or delay performance of this Contract if due to causes beyond BGE's reasonable control, including, but not limited to, acts of God, fire, explosion, shortages of fuel, any act or failure to act of any civil or military authority, or strikes.
18. Warranty Disclaimer. BGE MAKES NO PROMISE, GUARANTEE, REPRESENTATION, OR WARRANTY, WHETHER EXPRESS OR IMPLIED, AS TO THE SERVICES PERFORMED UNDER THIS CONTRACT, AND BGE EXPRESSLY DISCLAIMS ANY SUCH WARRANTY, INCLUDING, BUT NOT LIMITED TO, WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR COURSE OF DEALING.
19. Survival. The rights and obligations of the Parties set forth in Paragraphs 8, 9, 10, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23, and 25, and any other right or obligation of the Parties in this Contract which, by its express terms or nature and context is intended to survive termination or expiration of this Contract, shall survive any termination or expiration of this Contract.
20. Binding Effect; Assignment. This Contract shall be binding upon and shall inure to the benefit of the successors and assigns of the Parties hereto. Customer shall not assign any part of this Contract without the written consent of BGE.
21. No Waiver. Unless otherwise stated in this Contract, the Parties agree that the failure by either Party to enforce any term of this Contract shall not constitute a waiver of any rights or deprive either Party of the right to insist thereafter upon strict adherence to that or any other term of this Contract, nor shall a waiver of any breach of this Contract constitute a waiver of any preceding or succeeding breach. No waiver of any of the provisions of this Contract, unless expressly stated otherwise in this Contract, shall be valid and binding unless it is in writing and signed by the Party against whom it is sought to be enforced.
22. Severability. This Contract shall be enforceable to the fullest extent allowed by law. If any provision of this Contract shall be found to be null, unlawful, void, or inoperative for any reason, such provision shall be struck from this Contract and otherwise the Contract shall continue in full force and effect.
23. Governing Law; Jurisdiction. The validity and construction of this Contract or of any of its terms or provisions shall be determined under the laws of the State of Maryland, regardless of any principles of conflicts of laws or choice of laws of any jurisdiction. The Parties further agree that the courts of the State of Maryland shall have exclusive jurisdiction to resolve disputes that may arise between the Parties.
24. Counterparts. This Contract may be executed by the Parties in one or more identical counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument.
25. Entire Agreement. This Contract constitutes the entire agreement and understanding between the Parties and supersedes all prior agreements and understandings, whether written or oral, relating to the subject matter of this Contract. This Contract may be amended or modified only by a written instrument executed each Party. The language of all parts of this Contract shall in all cases be construed as a whole, according to its fair meaning, and not strictly for or against any of the Parties, notwithstanding any statutory or common law provisions which would suggest otherwise.

SPECIAL PROVISIONS

Builder's Risk Insurance

A. The Contractor shall, at his/her own cost, insure the work and keep it insured at all times during the period of construction, and until final acceptance of it by the County against loss of damage covered by an "All Risk" Builders Risk type of policy. The amount of insurance shall be the 100% estimated replacement cost of the work.

B. The policies shall be made payable to the County and the Contractor, as their interest may appear, and the policies shall be left in the possession of the Engineer, prior to the start of construction.

S E C T I O N I I I

Permits

2005

Baltimore County, Maryland
Department of Permits, Approvals, and Inspections
BUILDING PERMIT

Permit Number: CEN25-000066

Permit Type: Commercial Environmental

Sub Type: Grading

Date Issued: 06/06/2025

Expiration Date: 06/05/2027

Property Information

Property Address: 901 WALKER AVE

City, State, Zip: CATONSVILLE, MD, 21228

Tax ID: 2400000742

District: 01

Existing Use:

Proposed Use:

Is this property located in a Floodplain: NO

Sprinkler to be Installed?:

Plumbing Work?:

Electrical Work?:

Lot Size and Setbacks

Size:

Set Backs - Front Yard:

Set Backs - Rear Yard:

Set Backs - Right Side Yard:

Set Backs - Left Side Yard:

Owner Information

Owner: Baltimore County Property Management

Owner Address: 12200A Long Green Pike, Glen Arm, MD, 21057

Tenant:

Applicant: Alex Pagan

C. Pete Gutwald, AICP, Director

E. John Bryan, Building Engineer

***Please log into your account to get up-to-date information regarding the permit process and related inspections. Refer to the Permit Number when making inquires.**

Baltimore County, Maryland
Department of Permits, Approvals, and Inspections
BUILDING PERMIT

Permit Number: CEN25-000066

Permit Type: Commercial Environmental

Sub Type: Grading

Date Issued: 06/06/2025

Expiration Date: 06/05/2027

Building Permit Contractor

Name of Contractor: TBD

Phone Number:

Address:

City, State, Zip: , ,

Is Owner Contractor?:

Building Permit Information

Description of Work: Grade 125,356sf for new building and parking lot. Permit expires two years from date of issue. No construction to begin until pre-construction meeting. Failure to comply will result in penalties. Schedule your pre-construction meeting in your portal

C. Pete Gutwald, AICP, Director

E. John Bryan, Building Engineer

***Please log into your account to get up-to-date information regarding the permit process and related inspections. Refer to the Permit Number when making inquires.**

Baltimore County, Maryland
Department of Permits, Approvals, and Inspections
BUILDING PERMIT

Permit Number: C24-01031

Permit Type: Commercial New

Sub Type: New Structure - Shell

Date Issued: 07/10/2025

Expiration Date: 07/09/2026

Property Information

Property Address: 901 WALKER AVE

City, State, Zip: CATONSVILLE, MD, 21228

Tax ID: 2400000742

District: 01

Existing Use: Other

Proposed Use: A

Is this property located in a Floodplain: NO

Sprinkler to be Installed?: Yes

Plumbing Work?:

Electrical Work?:

Lot Size and Setbacks

Size: 33,950.00

Set Backs - Front Yard: 62.00

Set Backs - Rear Yard: 73.00

Set Backs - Right Side Yard: 128.00

Set Backs - Left Side Yard: 78.00

Owner Information

Owner: Baltimore County Property Management Office of Budget and Finance

Owner Address: Baltimore County Courthouse, Towson, MD, 21204

Tenant: Baltimore County Police Department

Applicant: Rebecca McCormick

C. Pete Gutwald, AICP, Director

E. John Bryan, Building Engineer

***Please log into your account to get up-to-date information regarding the permit process and related inspections. Refer to the Permit Number when making inquires.**

Baltimore County, Maryland
Department of Permits, Approvals, and Inspections
BUILDING PERMIT

Permit Number: C24-01031

Permit Type: Commercial New

Sub Type: New Structure - Shell

Date Issued: 07/10/2025

Expiration Date: 07/09/2026

Building Permit Contractor

Name of Contractor: TBD

Phone Number:

Address:

City, State, Zip: , ,

Is Owner Contractor?:

Building Permit Information

Description of Work: Construct 2-story police precinct 174'x172'x35'=33,950sf per plans. Separate razing, trades, tank, retaining wall, grading, stormwater and solar panel permits required. Erosion and Sediment Control Inspection must be scheduled and passed prior to any building activity. Existing precinct to remain during construction and to be razed after construction is complete.

C. Pete Gutwald, AICP, Director

E. John Bryan, Building Engineer

***Please log into your account to get up-to-date information regarding the permit process and related inspections. Refer to the Permit Number when making inquires.**

Baltimore County, Maryland
Department of Permits, Approvals, and Inspections
BUILDING PERMIT

Permit Number: C25-00993

Permit Type: Commercial Razing

Sub Type:

Date Issued: 07/17/2025

Expiration Date: 10/15/2025

Property Information

Property Address: 901 WALKER AVE

City, State, Zip: CATONSVILLE, MD,

Tax ID: 2400000742

District: 01

Existing Use:

Proposed Use:

Is this property located in a Floodplain: NO

Sprinkler to be Installed?:

Plumbing Work?:

Electrical Work?:

Lot Size and Setbacks

Size: 3,040.00

Set Backs - Front Yard:

Set Backs - Rear Yard:

Set Backs - Right Side Yard:

Set Backs - Left Side Yard:

Owner Information

Owner: BALTIMORE COUNTY MD

Owner Address: OLD COURTHOUSE, BALTIMORE, MD, 21204

Tenant: Wilkens Police

Applicant: Rebecca McCormick

C. Pete Gutwald, AICP, Director

E. John Bryan, Building Engineer

***Please log into your account to get up-to-date information regarding the permit process and related inspections. Refer to the Permit Number when making inquires.**

2010

07/17/2025

Baltimore County, Maryland
Department of Permits, Approvals, and Inspections
BUILDING PERMIT

Permit Number: C25-00993

Permit Type: Commercial Razing

Sub Type:

Date Issued: 07/17/2025

Expiration Date: 10/15/2025

Building Permit Contractor

Name of Contractor:

Phone Number:

Address:

City, State, Zip: , ,

Is Owner Contractor?:

Building Permit Information

Description of Work: Raze police station. To be torn down. Debris to be hauled to approved sanitary landfill in accordance with applicable Baltimore County site regulations. “Sewer to be capped & inspected before new building can be occupied. Cap off final will not hold up issue of razing”. Razing expires 90 days from issue date. Police station constructed in 2001. 3040sf See C24-01031 New structure.

C. Pete Gutwald, AICP, Director

E. John Bryan, Building Engineer

***Please log into your account to get up-to-date information regarding the permit process and related inspections. Refer to the Permit Number when making inquires.**

Baltimore County, Maryland
Department of Permits, Approvals, and Inspections
BUILDING PERMIT

Permit Number: CEN25-000067

Permit Type: Commercial Environmental

Sub Type: Storm Water

Date Issued: 06/26/2025

Expiration Date: 06/25/2027

Property Information

Property Address: 901 WALKER AVE

City, State, Zip: CATONSVILLE, MD, 21228

Tax ID: 2400000742

District: 01

Existing Use:

Proposed Use:

Is this property located in a Floodplain: NO

Sprinkler to be Installed?:

Plumbing Work?:

Electrical Work?:

Lot Size and Setbacks

Size:

Set Backs - Front Yard:

Set Backs - Rear Yard:

Set Backs - Right Side Yard:

Set Backs - Left Side Yard:

Owner Information

Owner: Baltimore County MD

Owner Address: 12200A Long Green Pike, Glen Arm, MD, 21057

Tenant:

Applicant: Alex Pagan

C. Pete Gutwald, AICP, Director

E. John Bryan, Building Engineer

***Please log into your account to get up-to-date information regarding the permit process and related inspections. Refer to the Permit Number when making inquires.**

Baltimore County, Maryland
Department of Permits, Approvals, and Inspections
BUILDING PERMIT

Permit Number: CEN25-000067

Permit Type: Commercial Environmental

Sub Type: Storm Water

Date Issued: 06/26/2025

Expiration Date: 06/25/2027

Building Permit Contractor

Name of Contractor: TBD

Phone Number:

Address:

City, State, Zip: , ,

Is Owner Contractor?:

Building Permit Information

Description of Work: Stormwater management for 2.88 acres drainage area. Permit expires 2 years from date of issue. No construction to begin until pre-construction meeting. Failure to comply will result in penalties. Schedule your pre-construction meeting in your portal.

C. Pete Gutwald, AICP, Director

E. John Bryan, Building Engineer

***Please log into your account to get up-to-date information regarding the permit process and related inspections. Refer to the Permit Number when making inquires.**

SECTION I V

Proposal

This Section to be Completed by Time of Bid

2014

S E C T I O N – I V
P R O P O S A L

DESCRIPTION OF WORK

Bid Opening via Teleconference WebEx: Thursday, November 13, 2025 @ 10:45 a.m. EST.
WebEx Phone Number 1-415-655-0001, Access Code Number 2307 029 0314##.

Begin Work Within Fifteen (15) Days After NOTICE TO PROCEED

Calendar Days for Completion: Six Hundred Sixty-Nine (669)

Liquidated and Other Damages: FIFTEEN HUNDRED DOLLARS ($1500.00 PER CALENDAR DAY)

Cost Group "H" ($15,000,001 to $30,000,000) (Prequalified contractors with a Cost Group restriction must bid within the dollar amount stated on their Certificate of Prequalification)

Work Classification: I1 w/ a prequalified I7 subcontractors

TO BALTIMORE COUNTY, MARYLAND: Work includes the construction of a new two-story police precinct building of approximately 33,800 square feet on the existing Wilkens police site. Demolition of free-standing building structures that currently exist on 3-acre site on the south west region will be demolished first to build the new building. The existing police station will be demolished after the completion of the new building. **Catonsville – District 1c1.**

The following listed Drawing Number(s) are collectively the "Drawings", and are hereby incorporated in the Contract.

Workday Number	Drawing Number(s)
300200006	2024-1314 thru 1611 & 2024 – 2096,2099,2100 ,2101

A pre-bid meeting will be held on Wednesday, October 29, 2025 at 10:00 a.m. EST via WebEx. *Phone-In (Audio Only)* – 1-415-655-0001, Meeting Number 2303 230 7730##. *Video Conference* – Meeting Number 2303 230 7730 , **Password**: **sGSYKJsy538,** go to https://signin.webex.com/join,or for the WebEx link go to www.baltimorecountymd.gov/departments/public-works/engineering/contracts/current-solicitations **A site visit is scheduled for Thursday, October 30, 2025 @ 2:00 P.M. EST.**

NOTE: No successful bidder may withdraw their bid within NINETY (90) days after the opening thereof.

The Contractor hereby declares that it has carefully examined the solicitation, plans and specifications, form of contract, Special Provisions and Drawings (collectively the "Contract Documents"). The Contractor also hereby declares that it has carefully examined the September 2023 "Standard Specifications for Construction and Materials" and "Standard Details for Contraction", collectively the "Applicable County Law" and any and all Department of Public Works and Transportation revisions thereto as of the date of advertisement. The Contract Documents, the Applicable County Law and the Department of Public Works and Transportation revisions thereto are collectively the "Specifications" and are incorporated herein. Copies of any and all Department of Public Works and Transportation revisions including but not limited to the General Conditions Building Projects, are available online at www.baltimorecountymd.gov/departments/public-works/standards. Also, the Contractor has, to its satisfaction, examined the locality of the proposed work and agrees to furnish all labor, tools, materials, machinery, equipment, and other means of construction called for in the manner provided in the Specifications for the prices shown on the next page(s) and as evidenced by Contractor's signature on the last page thereof.

SCHEDULE OF PRICES

NOTE: The Bidder shall fill out this Proposal, write in the unit prices in clear numerals, and make the extensions.

For complete information concerning these items, see Specifications and contract forms.

CONTRACT PROPOSAL

Wilkens Police Precinct New Building LEED SILVER CERTIFICATION - 901 Walker Avenue, Catonsville, MD. 21228
CONTRACT NUMBER: 2411 PP0
WORKDAY NUMBER: 300200006
JOB ORDER NUMBER: N/A
CALENDAR DAYS: 669

CONTRACTOR: _____
ADDRESS: _____
PHONE: _____

BID ITEM	COMM. CODE		DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT PRICE	TOTAL AMOUNT
1	0	0000	BASE BID - CONSTRUCTION OF NEW TWO-STORY POLICE PRECINCT BUILDING, PARKING LOT & SWM	LS	1		$
2	0	0000	ALTERNATE #1 - INCREASE LEVEL 3 TO LEVEL 5 BALLISTIC RATINGS 1ST FLOOR EXTERIOR STOREFRONT SYSTEM & GLAZING	LS	1		$
3	0	0000	BASE BID + ALT. #1 TOTAL				$
4	0	0000	ALTERNATE #2 - PROVIDE LEVEL 5 BALLISTIC RATED STOREFRONT SYSTEM & GLAZING (ALL 2ND FLOOR TYPE W-1 WINDOWS)	LS	1		$
5	0	0000	BASE BID + ALT. #1 + ALT. #2 TOTAL				$
6	0	0000	ALTERNATE #3 - ADD A SINGLE DUPLEX RECEPTACLE TO EACH WELDED METAL STORAGE LOCKERS	LS	1		$
7	0	0000	BASE BID + ALT. #1 + ALT. #2 + ALT. #3 TOTAL				$
8	0	0000	W/ AUTOMATIC OPERATOR (PDXT SPEEDGATE BY WALLACE PERIMETER)	LS	1		$
9	0	0000	BASE BID + ALT. #1 + ALT. #2 + ALT. #3 + ALT. # 4 TOTAL				$
10	0	0000	ALTERNATE #5 - PROVIDE ADULT CHANGING STATION IN RESTROOM 126 (DESIGN - KOALA KARE MOD.#KB3000-AHL OR APPROVED EQUAL)	LS	1		$
TOTAL COST FOR CONTRACT (BASE BID + ALTERNATES 1-5 TOTAL)							$

_____
TOTAL COST FOR CONTRACT IN WORDS

_____ _____
OFFICER SIGNATURE 2016 TITLE

PROPOSAL AFFIDAVIT

1. AUTHORIZED REPRESENTATIVE

I HEREBY AFFIRM THAT:

I am the [title]_____and the duly authorized representative of [business]_____(the "Business") and that I possess the legal authority to make this Affidavit on behalf of myself and the Business for which I am acting.

2. PROPOSAL CERTIFICATION

THE UNDERSIGNED HEREBY ACKNOWLEDGES receipt of the following Addenda (list by number and date):

_____

_____

Accompanying this Proposal is a Bid Bond in an amount of 5% of the bid, the exact amount to be determined by the difference between the low bid and the next lowest bid, if two or more bids are received, or 5% of the bid if one bid is received. This guarantees payment to Baltimore County of the amount thus determined as liquidated damages in case of default in any matter specified as required before award or in any matter resulting in failure to execute and deliver an Agreement, together with Payment and Performance Bonds, after award.

3. AFFIRMATION REGARDING BRIBERY CONVICTIONS

I FURTHER AFFIRM THAT:

Neither I, nor to the best of my knowledge, information, and belief, the Business, nor any of its officers, directors, partners, or any of its employees directly involved in obtaining or performing contracts with public bodies (as is defined in Section 16-101(f) of the State Finance and Procurement Article of the Annotated Code of Maryland), has been convicted of, or has had probation before judgment imposed pursuant to Section 6-225 of the Criminal Procedure Article of the Annotated Code of Maryland, or has pleaded nolo contendere to a charge of, bribery, attempted bribery, or conspiracy to bribe in violation of Maryland law, or of the law of any other state or federal law, except as follows [indicate the reasons why the affirmation cannot be given and list any conviction, plea, or imposition of probation before judgment with the date, court, official or administrative body, the sentence or disposition, the name(s) of person(s) involved, and their current positions and responsibilities with the Business]:

_____

_____

4. AFFIRMATION REGARDING OTHER CONVICTIONS

I FURTHER AFFIRM THAT:

Neither I, nor to the best of my knowledge, information, and belief, the Business, nor any of its officers, directors, partners, or any of its employees directly involved in obtaining or performing contracts with public bodies, has:

(1) Been convicted under state or federal statute of a criminal offense incident to obtaining, attempting to obtain, or performing a public or private contract, fraud, embezzlement, theft, forgery, falsification or destruction of records, or receiving stolen property;

(2) Been convicted of any criminal violation of a state or federal antitrust statute;

(3) Been convicted under the provisions of Title 18 of the United States Code for violation of the Racketeer Influenced and Corrupt Organization Act, 18 U.S.C. §1961, et seq., or the Mail Fraud Act, 18 U.S.C. §1341, et seq., for acts arising out of the submission of bids or proposals for a public or private contract;

(4) Been convicted of a violation of the State Minority Business Enterprise Law, Section 14-308 of the State Finance and Procurement Article of the Annotated Code of Maryland;

(5) Been convicted of conspiracy to commit any act or omission that would constitute grounds for conviction or liability under any law or statute described in subsection (1), (2), (3), or (4) above;

(6) Been found civilly liable under a state or federal antitrust statute for acts or omissions in connection with the submission of bids or proposals for a public or private contract;

(7) Admitted in writing or under oath, during the course of an official investigation or other proceedings, acts or omissions that would constitute grounds for conviction or liability under any law or statute described above, except as follows [indicate reasons why the affirmations cannot be given, and list any conviction, plea, or imposition of probation before judgment with the date, court, official or administrative body, the sentence or disposition, the name(s) of the person(s) involved and their current positions and responsibilities with the Business, and the status of any debarment]:

_____

_____

5. AFFIRMATION REGARDING DEBARMENT

I FURTHER AFFIRM THAT:

Neither I, nor to the best of my knowledge, information, and belief, the Business, nor any of its officers, directors, partners, or any of its employees directly involved in obtaining or performing contracts with public bodies, has ever been suspended or debarred (including being issued a limited denial of participation) by any public entity, except as follows [list each debarment or suspension providing the dates of the suspension or debarment, the name of the public entity and the status of the proceeding, the name(s) of the person(s) involved and their current positions and responsibilities with the Business, the grounds of the debarment or suspension, and the details of each person's involvement in any activity that formed the grounds of the debarment or suspension]:

_____

_____

6. AFFIRMATION REGARDING DEBARMENT OF RELATED ENTITIES

I FURTHER AFFIRM THAT:

(1) The Business was not established and it does not operate in a manner designed to evade the application of or defeat the purpose of debarment pursuant to Sections 16-101, et seq., of the State Finance and Procurement Article of the Annotated Code of Maryland; and

(2) The Business is not a successor, assignee, subsidiary, or affiliate of a suspended or debarred business, except as follows: [you must indicate the reasons why the affirmations cannot be given without qualification]:

_____

_____

7. SUB-CONTRACT AFFIRMATION

I FURTHER AFFIRM THAT:

Neither I, nor to the best of my knowledge, information, and belief, the Business, has knowingly entered into a contract with a public body under which a person debarred or suspended under Title 16 of the State Finance and Procurement Article of the Annotated Code of Maryland will provide, directly or indirectly, supplies, services, architectural services, construction related services, leases of real property, or construction.

8. AFFIRMATION REGARDING COLLUSION

I FURTHER AFFIRM THAT:

Neither I, nor to the best of my knowledge, information, and belief, the Business, nor any of its officers, directors, members or partners, nor any of its employees, have in any way:

(1) Agreed, conspired, connived, or colluded to produce a deceptive show of competition in the compilation of the accompanying bid or offer that is being submitted;

(2) In any manner, directly or indirectly, entered into any agreement of any kind to fix the bid price or price proposal of the bidder or offeror or of any competitor, or otherwise take any action in restraint of free competitive bidding in connection with the contract for which the accompanying bid or offer is submitted;

(3) Colluded with anyone to obtain information concerning the bid that would give the Business an unfair advantage over others.

9. POLITICAL CONTRIBUTION DISCLOSURE AFFIRMATION

I FURTHER AFFIRM THAT:

The Business affirms that it is aware of, and will comply with, the provisions of Sections 14- 101 through 14-108 of the Election Law Article of the Annotated Code of Maryland, which require that every person who makes, during any 12-month period, one or more contracts, with one or more Maryland governmental entities involving cumulative consideration, or at least $200,000.00, shall file with the State Board of Elections certain specified information to include disclosure of attributable political contributions in excess of $500 during defined reporting periods.

l0. CERTIFICATION OF CORPORATION REGISTRATION AND TAX PAYMENT

I FURTHER AFFIRM THAT:

(1) The Business is a _____ *(State)* (Corporation), (LLC), (Partnership), (Sole Proprietor/Individual), (Other:_____), that it **is** registered in accordance with the Corporations and Associations Article of the Annotated Code of Maryland, that it **is** in good standing in the State of Maryland, and that it **has** filed all of its annual reports, together with filing fees, with the Maryland State Department of Assessments and Taxation, and that the name and address of its resident agent filed with the State Department of Assessments and Taxation is:

Name: _____

Address: _____

_____

(If none, so state)

(2) Except as validly contested, the Business has paid, or has arranged for payment of, all taxes due the State of Maryland and Baltimore County, and has filed all required returns and reports with the Comptroller of the Treasury, the State Department of Assessments and Taxation, and the Employment Security Administration, as applicable, and will have paid all withholding taxes due the State of Maryland prior to final settlement.

11. CONTINGENT FEES

I FURTHER AFFIRM THAT:

The Business has not employed or retained any person, partnership, corporation, or other entity, other than a bona fide employee or agent working for the Business, to solicit or secure the Contract, and that the Business has not paid or agreed to pay any person, partnership, corporation, or other entity, other than a bona fide employee or agent, any fee or other consideration contingent on the making of the Contract.

12. NONDISCRIMINATION IN EMPLOYMENT STATEMENT

I FURTHER AFFIRM THAT:

During the performance of any contract awarded of which this affidavit is a part:

(1) The Business will not discriminate against any employee or applicant for employment because of race, color, religion, sex, age, national origin, marital status, sexual orientation, genetic information, or disability unrelated in nature and extent so as to reasonably preclude the performance of the employment, or because of the individual's refusal to submit to a genetic test or make available the results of a genetic test. The Business will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, age, national origin, marital status, sexual orientation, genetic information, or disability unrelated in nature and extent so as to reasonably preclude the performance of the employment, or because of the individual's refusal to submit to a genetic test or make available the results of a genetic test. Such action shall include, but not be limited to the following: employment, promotion, upgrading, demotion or transfer, rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Business agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the owner setting forth provisions of this nondiscrimination clause.

(2) The Business will, in all solicitations or advertisements for employees placed by or on behalf of the Business, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, age, national origin, marital status, sexual orientation, genetic information, or disability unrelated in nature and extent so as to reasonably preclude the performance of the employment, or because of the individual's refusal to submit to a genetic test or make available the results of a genetic test.

(3) The Business shall send to each labor union or representative of workers with which the Business has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the owner, advising the said labor union or workers' representative of these commitments, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The Business shall furnish, if requested by the County, a compliance report concerning our employment practices and policies in order for the County to ascertain compliance with the special provisions of this affidavit concerning nondiscrimination in employment.

(5) In the event of the Business's noncompliance with the nondiscrimination clause of this affidavit, the contract may be canceled, terminated, or suspended in whole or in part, and the Business may be declared ineligible for further County work.

(6) The Business shall include the special provisions outlined herein pertaining to nondiscrimination in employment in every subcontract, so that such nondiscrimination in employment provisions shall be binding on each subcontractor or vendor.

13. FOREIGN CONTRACTS

I FURTHER AFFIRM THAT:

The Business affirms that it is aware of, and will comply with, the provisions of Sections 10-2-110 Article 10. Finance, Title 2 – Purchasing, Baltimore County Code 2003, which requires that prior to the award of a contract for services under the provisions of this title, and during the entire term of a contract award, the bidder or vendor shall disclose to the County whether any services covered by the bid or contract, including any subcontracted services, will be performed outside the United States. The disclosure shall be made to the Office of Budget and Finance, Purchasing Bureau.

14. MINORITY BUSINESS ENTERPRISE AND FEMALE CONTRACTORS

THIS BUSINESS INTENDS to affirmatively seek out and consider minority business enterprises to participate in this contract as subcontractors and/or suppliers of materials and services.

THE UNDERSIGNED UNDERSTANDS AND AGREES: that any and all subcontracting of supplies and services in connection with this contract, whether undertaken before or after award of contract, will be in accordance with the Minority Business Enterprise and Female Contractor requirement included in the Bid Proposal package and incorporated herein as if fully set forth; and

THE UNDERSIGNED ALSO UNDERSTANDS AND AGREES that no subcontracting will be approved until Baltimore County has reviewed and approved the affirmative actions taken by this firm.

15. REQUIREMENTS FOR EXECUTING AFFIDAVIT & PROPOSAL

The Affidavit must be signed in ink in order for the bid to be accepted and that the Proposal must be typewritten or filled out in ink.

THE UNDERSIGNED ALSO UNDERSTANDS that:

Proposals submitted by an INDIVIDUAL must be signed by an individual.

Proposals submitted by a PARTNERSHIP must be signed by the partner who is legally authorized authority to bind the partnership. Attach a copy of the Partnership Agreement and a duly certified resolution evidencing the authority of the partner so signing on behalf of the partnership.

Proposals submitted by a CORPORATION must be signed by a legally authorized officer of the corporation and attested to by the Corporate Secretary. Attach a copy of the Articles of Incorporation, By-Laws and a duly certified Board Resolution evidencing the authority of the officer so signing on behalf of the corporation.

Proposals submitted by a LIMITED LIABILITY COMPANY must be signed by a legally authorized member of the company and attested to. Attach a copy of the Operating Agreement, Articles of Organization and a duly certified resolution evidencing the authority of the member so signing on behalf of the limited liability company.

NOTE: The contractor may file with the County a list of the names of those officers, partners or members, as applicable, having legal authority to execute documents on behalf of and legally bind the contractor, duly certified, as applicable and legally required, together with the aforesaid corporate documents, which shall remain in full force and effect until such time as the County Department of Public Works and Transportation, Construction Contract Administration is advised in writing to the contrary.

16. ACKNOWLEDGMENT

I ACKNOWLEDGE THAT this Affidavit is to be furnished to the County and may be distributed to units of (1) Baltimore County; (2) the State of Maryland; (3) other counties or political subdivisions of the State of Maryland; (4) other states; and (5) the federal government. I further acknowledge that this Affidavit is subject to applicable laws of the United States and the State of Maryland, both criminal and civil, and that nothing in this Affidavit or any contract resulting from the submission of this bid or proposal shall be construed to supersede, amend, modify or waive, on behalf of Baltimore County, or the State of Maryland or any unit of the State of Maryland having jurisdiction, the exercise of any statutory right or remedy conferred by the Constitution and the laws of Maryland with respect to any misrepresentation made or any violation of the obligations, terms and covenants undertaken by the Business with respect to (a) this Affidavit, (b) the contract, and (3) other Affidavits comprising part of the contract.

I DO SOLEMNLY DECLARE AND AFFIRM UNDER THE PENALTIES OF PERJURY THAT THE CONTENTS OF THIS AFFIDAVIT ARE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE, INFORMATION, AND BELIEF.

WITNESS/ATTEST:

_____ By: _____

Name: _____

Date: _____ Title: _____

(Authorized Representative and Affiant)

BID BOND

Principal | **Business Address of Principal**

Surety

Obligee: **BALTIMORE COUNTY, MARYLAND**
A body corporate and politic

A Corporation of the State of _____ **and authorized to do business in Maryland**

Five Percent of Bid Amount **$** **5% of Bid**
Penal Sum of Bond [shall be determined pursuant to latest revised Specification / G.P. 2.07 (2000 Ed.)]

Wilkens Police Precinct New Building
Contract Name

24111 PP0
Contract Number/Proposal Item Number

KNOW ALL MEN BY THESE PRESENTS, that we, the Principal, above named, and Surety, above named, and authorized to do business in the State of Maryland, are held and firmly bound unto the Obligee, above named, in the penal sum of the amount stated above, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that if the aforesaid Principal is the apparent low bidder and complies with all specified matters required before award or if the aforesaid Principal is awarded the contract, the said Principal will, within the time required, execute and deliver to the Obligee a formal contract and good and sufficient payment and performance bonds in the form provided by the Obligee, then, this obligation to be void; otherwise the Principal and Surety will, upon demand, pay unto the Obligee the entire Penal Sum of this Bid Bond as liquidated damages.

THE SURETY FURTHER GUARANTEES No Proposal will be considered unless accompanied by a guaranty of the amount specified in the Proposal in the form of either a certified check, bank cashier's check or a Bid Bond on the form provided therein or an exact facsimile thereof. The Bid Bond must be executed by a Surety that is, as of the date of the Bid: (a) licensed in the State of Maryland, (b) rated "B" or better by the A.M. Best Company, (c) on federal funded projects, authorized by the underwriting limitation contained in the U.S. Department of the Treasury Circular 570, as amended, to guaranty the amount of the Bid, and (d) in good standing as determined by the County's Engineer. The Bid Bond must guaranty payment to the County of liquidated damages as follows: (a) if only one Bid is received, the guaranteed payment shall be five (5%) percent of the Bidder's Bid amount, (b) if two or more Bids are received, the guaranteed payment shall be the difference between the Bidder's Bid amount and the next lowest Bid amount, subject to the limitation that the guaranteed payment not be greater than five (5%) percent of the Bidder's Bid amount. This Bid Bond is required in case the successful Bidder, after issuance of notice of Award, fails to comply, timely and completely, with each of the requirements set forth under Section GP-3.04.

Signed and sealed _____
Date

IN WITNESS WHEREOF, the above-bounded parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

In Presence of: **Individual Principal**

Witness: _____ **as to:** _____ **(SEAL)**

Print Name: _____ **Print Name:** _____

Corporate Principal

In Presence of:

_____
(Name of Corporation)

Witness: _____ **By:** _____

Print Name: _____ **Print Name:** _____ **(SEAL)**

Title: _____

Surety

_____
(Name of Surety)

Business Address: _____

Witness: _____ **By:** _____ Affix

Print Name: _____ **Print Name:** _____ Corporate

Title: _____ Seal

Revised
February 4, 2015

BALTIMORE COUNTY
PREVAILING WAGE AND LOCAL HIRING

AFFIDAVIT

(Project Name) _____
Proposal No.: _____
Project No.: _____

On behalf of_____, I do solemnly declare and affirm,
(Contractor)
under penalty of perjury, that to the best of my knowledge, information, and belief:

1. I have submitted all documentation in accordance with Baltimore County Code § 10-2- 506 and § 10-2-507 regarding the prevailing wage and local hiring laws and requirements of the prevailing wage guidelines located at (Prevailing Wage and Local Hire Laws), and acknowledge that I have read and agree to all provisions of said law, as amended, and have a continuing obligation to be compliant with the law and any changes to the law.

2. I shall not knowingly provide any false information relating to payroll documentation and/or hiring of local employees for capital improvement contracts that are subject to the prevailing wage and/or local hiring laws of Baltimore County. I further attest and certify that all documentation relating to the same will be accurate and complete and will remain accurate and complete on an ongoing basis, and will reflect the payroll and/or local hiring status of contractors, subcontractors, apprentices, and independent contractors performing work for the Contract (contract number_____). I acknowledge that I have been informed and am aware of the foregoing requirements and that I am authorized to make this certification on behalf of myself and all subcontractors and parties performing work pursuant to this Contract.

3. I certify and attest that I am an officer or agent of the Contractor or subcontractor who supervises the payment of employees. I understand and agree that all documentation related to prevailing wages and/or local hiring required by law shall be submitted to Baltimore County's Prevailing Wage Administrator or designee before any surety is released or final payment due under the terms of the Contract is made.

4. I further certify and attest that I will have personal knowledge of the wages paid to all employees of_____for work performed on the Contract and of all of the hours worked, and that I am an authorized agent of the Contractor and assume responsibility for my actions.

5. I further certify and attest that_____will comply with prevailing wage rates set by the State of Maryland as the same apply to the Contract and are a part of the bid documents and Contract, and that_____will comply with applicable local hiring requirements.

6. I attest and certify that, if the Contract is subject to the local hiring requirement under §10-2-507 of the Baltimore County Code, _____ will make best efforts to ensure that residents of Baltimore County constitute at least 51% of the new hires made for the Contract, subject to all exceptions allowable by law.

7. I certify and attest that, if the Contract is subject to prevailing wage requirements, no rebates or deductions will be made, directly or indirectly, from any wages paid in connection with the Contract, other than those provided for by law.

8. I certify and attest that, if awarded the Contract and if the Contract is subject to prevailing wage law, I will submit certified payroll to the County through its electronic compliance system or as instructed by the Prevailing Wage and Local Hire Unit.

9. I certify that if awarded the Contract, I will provide a list of subcontractors who will participate as a beneficiary of this project to the agency and the Prevailing Wage and Local Hire Unit at PrevailingWage@baltimorecountymd.gov.

10. I understand that no funds will be dispersed by the County until an Employment Analysis has been issued to the Prevailing Wage and Local Hire Unit in compliance with the local hire law. The Employment Analysis will include how many jobs will be required to complete the project; how many current employees are available to complete the project, and how many of those jobs will require new hires.

_____
Contractor/Bidder/Offeror

_____
By

_____
Printed Name

_____
Printed Title

_____
Date

_____
Phone

_____
License Number

_____
Business Email

BALTIMORE COUNTY, MARYLAND

Prevailing Wage and Local Hiring Contract Requirements and Policies

The Contractor and all Subcontractors must comply with the Prevailing Wage and Local Hiring Laws, contained in Baltimore County Code § 10-2-506 and § 10-2-507, respectively, as amended. Prevailing wage means the wage rate paid by employers that is determined by a governmental authority, based upon a particular geographic area, for a given class of labor and type of project. The County will use the prevailing wage established by the State of Maryland (the "State") Department of Labor for state funded construction contracts in the County at the time of award. These rates include the basic hourly rate and fringe benefits. Apprentices must be paid at least the rate that the State's Apprenticeship and Training Council sets for an apprentice in the trade involved, based on a percentage of the prevailing wage rate in that trade. Any Contractor that is subject to the prevailing wage or local hiring law will be required to agree to the below provisions:

For the purposes of these requirements, an employee means an apprentice, laborer or mechanic employed by a contractor or subcontractor on a capital improvement project with a value of over $300,000 or a County-subsidized capital project with a value over $5,000,000.

Capital Improvement Project does not include blanket order or open-end agreements, capital improvement projects subject to a federal or state prevailing wage law, awarded without competition; with another governmental entity; to the extent the contractor is precluded from compliance by the terms of any federal or state law, contract or grant; entered into pursuant to Baltimore County Code § 10-2-310(e); entered into as a joint or cooperative purchase; or entered into as an emergency purchase.

The purpose of a prevailing wage is to ensure that contractors institute local hiring practices for Capital Improvement contracts and Capital Projects under certain circumstances as required by law, and that the Contractor's employees who work on capital improvement contracts are paid the going rate for their services. The prevailing wage rates are established by the State of Maryland Department of Labor and apply to all of the Contractor's employees and any and all Subcontractors. The Contractor and all Subcontractors must comply with all of the requirements of the Prevailing Wage Law including, but not limited to, the following:

1. Pay employees the prescribed rate as annually established by the State's Department of Labor; the prevailing wage rates in effect on the date a solicitation is issued and will apply throughout the term of a contract resulting from that solicitation. Contractor or subcontractors may NOT split or subdivide a capital improvement contract, pay an employee through a third party, treat an employee as a subcontractor or independent contractor to avoid any requirement of the County's prevailing wage law; or employ an individual classified as a helper or trainee to perform direct and measurable work on a capital improvement contract.

2. Pay employees at a rate equal to or more than the prevailing wage rate currently in effect for the type of work performed.

3. Pay employees overtime for work (I) more than eight hours in any single calendar day; (II) more than 40 hours in a work week; or (III) on a Sunday or a legal holiday.

4. Classify employees in their proper work classification in conformance with the schedule established by the State's Department of Labor.

5. May only make fair and reasonable deductions that are (a) required by law; (b) authorized in a written agreement between an employee and contractor or subcontractor signed at the beginning of employment (any deductions taken from employee paychecks including healthcare, pension, 401K, IRA, etc., child/spouse support, or tax levies); and submitted by the contractor or subcontractor to the Director of the County's Prevailing Wage Program; or required or allowed by a collective bargaining agreement between a bona fide labor organization and a contractor or subcontractor.

> Electronically submit a certified copy of payroll records through the County's designated certified payroll and compliance system within 14 days after the end of payroll week ending date, to verify that Prevailing Wage rates have been paid to employees.

6. Backup documentation may be required upon demand from the County to be submitted for all 3rd party benefits being claimed, to include, but not limited to: *one month's healthcare transmittal showing employee name and amount company pays on their behalf, company vacation/sick policy, etc. or if Union, a Union transmittal for one month in which work has been performed*.

7. Retain records for a period of five (5) years after the work is completed and permit the Director of the County Prevailing Wage Program, or his/her designee, to inspect the payroll records at a reasonable time and as often as necessary.

8. Payroll records shall contain a statement signed by the contractor or subcontractor (including tiered subcontractors) certifying that the payroll records are complete and correct; the wage rates are not less than required by the Prevailing Wage Law; and the rate of pay and classification for each employee accurately reflects the work the employee performed.

9. All payroll records shall include the name, address, telephone number and email address of the contractor or subcontractor; the name and location of the job; and each employee's name, current address, unless previously reported; specific work classification; daily basic time and overtime hours; total basic time and overtime hours for the payroll period; rate of pay; fringe benefits by type and amount; and gross wages, and any deductions taken from employees' paychecks including, but not limited to, healthcare, pension/401K/IRA. Late submission of copies of any payroll records may be deemed deficient by the County until the required records are provided, and the County may postpone processing payments due under the Contract or under an agreement to finance the Contract.

10. Submit to random or regular audits and investigation of any complaint of a violation of the County's Prevailing Wage and Local Hiring Laws and requirements.

11. Make best efforts to fill at least 51% of new jobs required to complete the capital improvement contract or capital project with Baltimore County residents.

12. Submit monthly reports to the Director of the County's Prevailing Wage Unit relating to local hiring with respect to capital improvement contracts over $300,00 or County-subsidized capital construction projects receiving assistance over $5,000,000, that includes (a) the number of new hires needed for the contract or project, (b) the number of County residents hired during the reporting period, (c) the total number of all employees hired during the contract period, (d) best efforts made to fill open positions with County residents, and(e) 5) for new hires: name, last four (4) digits of the social security number, job title, hire date, address and referral source.

13. Agree that any and all disputes will be handled as set forth in the County's Prevailing Wage and Local Hire as a condition of award.

14. In the event the County determines that a provision of the Prevailing Wage and/or Local Hire Law has been violated, the County shall issue a written decision, including appropriate sanctions, and may withhold payment due the Contractor in an amount sufficient to pay each employee of the Contractor or any subcontractors the full amount of wages due under the Prevailing Wage Law, and an amount sufficient to satisfy a liability of the Contractor for liquidated damages as provided under the Prevailing Wage Law, pending a final decision on the violation by the County. The Contractor may appeal a written decision of the Director of the County's Prevailing Wage Unit that the Contractor violated a provision of the Prevailing Wage and/or Local Hire Law, to the Office of Administrative Hearings ("OAH"), within ten (10) working days after receiving a copy of the decision. OAH will conduct a hearing upon the receipt of a timely appeal. If no appeal, the decision of the Director of the County's Prevailing Wage Unit or his/her designee becomes final. A Contractor who is found to have violated the provisions of the Prevailing Wage or Local Hiring Laws intentionally, may not be awarded a County contract or work on any County project for a period of one year from the date of the OAH determination.

15. May not discharge, or otherwise retaliate against, an employee for asserting any right under the Prevailing Wage Law or for filing a complaint of a violation;

16. An aggrieved employee is a third-party beneficiary of the Contract and may by civil action recover the difference between the prevailing wage for the type of work performed and the amount actually received, with interest and a reasonable attorney's fee.

17. Each Contract subject to the Prevailing Wage and Local Hire Laws may specify the payment of liquidated damages to the County by the Contractor for any noncompliance with the Prevailing Wage and Local Law. Liquidated damages are:

a. $10 for each calendar day that the payroll records are late (payrolls are to be submitted no later than 14 days after the week ending date shown on Certified Payroll Record CPR); $20 for each day that an employee is misclassified and/or paid less than the prevailing

wage rate; and a civil penalty of $50 per violation of the requirement to post the prevailing wage rates at the work site.

b. $50 per month for each month the Local Hire report is not submitted by the last day of the existing month due.

These liquidated damages are solely related to prevailing wage and local hiring compliance and do not negate any other remedies available or set forth in the Contract, including delay damages or actual damages. These remedies are separate from, in addition to, and not in lieu of, any remedies available and set forth in the Contract, or at law, for other breaches or defaults under the Contract.

18. Where the initial Contract Sum is $300,000 or below, but it is subsequently increased and exceeds $300,000 due to an approved Contract Modification, the amount of any such Contract Modification that causes the Contract Sum to exceed $300,000 is subject to the Prevailing Wage and Local Hiring Laws.

19. The Contractor and all subcontractors must post a clearly legible statement of each prevailing wage rate in a prominent and easily accessible place at the Work Site during the entire time Work is being performed, in English and any other language that is primarily spoken by the employees, at the Work Site.

20. A contract may include the actual cost of health and dental insurance, pension or retirement plan, paid time off such as vacation or sick daysand life insurance. In calculating the cost per hour, divide the annual cost of benefits by 2,080 hours for each employee. Other benefits such as the use of a company vehicle, cell phones, lodging reimbursement, company owned tools **may not be credited towards the fringe benefit amount**.

21. All apprentices must be registered with the Maryland Apprenticeship and Training Council, V.A., or US DOL as well as be currently enrolled in, and attending appropriate classes, to which is considered “actively enrolled”. Only actively enrolled apprentices may be employed on the project at the apprentice prevailing wage rate.

CONTRACT NUMBER: **24111 PP0**

BALTIMORE COUNTY PREVAILING WAGE RATES
BUILDING CONSTRUCTION

Print Date 10/7/2025

Classification	Modification Reason	Basic Hourly Rate	Borrowed From	Fringe Benefit Payment
BALANCING TECHNICIAN	AD	$47.92		$24.44
BRICKLAYER	AD	$37.50		$14.78
CARPENTER	AD	$34.41		$14.49
CARPENTER - SHORING SCAFFOLD BUILDER	AD	$34.41		$14.49
CARPET LAYER	AD	$34.12		$14.86
CEMENT MASON	AD	$25.00	510	$1.94
COMMUNICATION INSTALLER TECHNICIAN	AD	$36.37		$12.89
DRYWALL - SPACKLING, TAPING, & FINISHING	AD	$34.41		$14.49
ELECTRICIAN	AD	$47.13		$21.94
ELEVATOR MECHANIC	AD	$56.36		$45.50
FIRESTOPPER	AD	$29.81		$10.08
GLAZIER	AD	$35.60		$14.41
INSULATION WORKER	AD	$40.02		$19.92
IRONWORKER - FENCE ERECTOR	AD	$40.02		$19.92
IRONWORKER - ORNAMENTAL	AD	$31.17	510	$24.38
IRONWORKER - REINFORCING	AD	$29.20	510	$23.57
IRONWORKER - STRUCTURAL	AD	$33.12		$25.63
LABORER - AIR TOOL OPERATOR	AD	$24.46		$9.69
LABORER - ASPHALT PAVER	AD	$24.46		$9.69
LABORER - ASPHALT RAKER	AD	$22.63		$4.88
LABORER - BLASTER - DYNAMITE	AD	$24.46		$9.69
LABORER - BURNER	AD	$24.46		$9.69
LABORER - COMMON	AD	$22.63		$4.88
LABORER - CONCRETE PUDDLER	AD	$22.63		$4.88
LABORER - CONCRETE SURFACER	AD	$24.46		$9.69
LABORER - CONCRETE TENDER	AD	$22.63		$4.88
LABORER - CONCRETE VIBRATOR	AD	$22.63		$4.88
LABORER - DENSITY GAUGE	AD	$22.63		$4.88
LABORER - FIREPROOFER - MIXER	AD	$22.63		$4.88
LABORER - FLAGGER	AD	$22.63		$4.88
LABORER - GRADE CHECKER	AD	$22.63		$4.88
LABORER - HAND ROLLER	AD	$22.63		$4.88
LABORER - HAZARDOUS MATERIAL HANDLER	AD	$24.46		$9.69
LABORER - JACKHAMMER	AD	$22.63		$4.88
LABORER - LANDSCAPING	AD	$22.63		$4.88
LABORER - LAYOUT	AD	$22.63		$4.88
LABORER - LUTEMAN	AD	$22.63		$4.88
LABORER - MASON TENDER	AD	$24.46		$9.69
LABORER - MORTAR MIXER	AD	$22.63		$4.88
LABORER - PIPELAYER	AD	$24.46		$9.69
LABORER - PLASTERER - HANDLER	AD	$22.63		$4.88
LABORER - SCAFFOLD BUILDER	AD	$24.46		$9.69
LABORER - TAMPER	AD	$22.63		$4.88
MECHANICAL SYSTEMS SERVICE TECH - ELECTRICAL SYSTEMS	AD	$46.21	510	$24.90

MECHANICAL SYSTEMS SERVICE TECH-HVAC SYSTEMS	AD	$46.21		$24.90
MECHANICAL SYSTEMS SERVICE TECH-PLUMBING SYSTEMS	AD	$46.21		$24.90
MECHANICAL SYSTEMS SERVICE TECH - REFRIGERATION SYSTEMS	AD	$52.27	003	$24.58
MILLWRIGHT	AD	$38.61		$17.21
PAINTER	AD	$28.55		$11.87
PAINTER-INDUSTRIAL	AD	$35.55		$15.28
PILEDRIVER	AD	$36.60		$16.78
PLUMBER	AD	$46.21		$24.90
POWER EQUIPMENT OPERATOR - BACKHOE	AD	$33.00	510	$13.55
POWER EQUIPMENT OPERATOR - BROOM / SWEEPER	AD	$32.23	510	$14.62
POWER EQUIPMENT OPERATOR - BULLDOZER	AD	$34.18		$14.62
POWER EQUIPMENT OPERATOR - CONCRETE PUMP	AD	$44.35		$0.00
POWER EQUIPMENT OPERATOR - CRANE	AD	$41.00		$18.10
POWER EQUIPMENT OPERATOR - CRANE - TOWER	AD	$41.00		$18.10
POWER EQUIPMENT OPERATOR - DRILL - RIG	AD	$33.16		$14.15
POWER EQUIPMENT OPERATOR - EXCAVATOR	AD	$34.18		$14.62
POWER EQUIPMENT OPERATOR - FORKLIFT	AD	$34.18		$14.62
POWER EQUIPMENT OPERATOR - GRADALL	AD	$34.00	510	$13.55
POWER EQUIPMENT OPERATOR - GRADER	AD	$34.18		$14.62
POWER EQUIPMENT OPERATOR - GUARD RAIL POST DRIVER	AD	$23.50		$5.07
POWER EQUIPMENT OPERATOR - LOADER	AD	$34.18		$14.62
POWER EQUIPMENT OPERATOR - MECHANIC	AD	$36.24		$14.62
POWER EQUIPMENT OPERATOR - MILLING MACHINE	AD	$30.58	510	$13.55
POWER EQUIPMENT OPERATOR - PAVER	AD	$32.10	510	$13.55
POWER EQUIPMENT OPERATOR - ROLLER - ASPHALT	AD	$32.10	510	$13.55
POWER EQUIPMENT OPERATOR - ROLLER - EARTH	AD	$28.60		$14.62
POWER EQUIPMENT OPERATOR - SCREED	AD	$30.00	510	$11.80
POWER EQUIPMENT OPERATOR - SKID STEER (BOBCAT)	AD	$32.23		$14.62
POWER EQUIPMENT OPERATOR-VACUUM TRUCK	AD	$37.50		$14.85
RESILIENT FLOOR	AD	$34.12		$14.86
SHEETMETAL WORKER (INCLUDING METAL ROOFING)	AD	$47.92		$24.44
SPRINKLERFITTER	AD	$42.32	510	$26.05
SPRINKLERFITTER/PIPEFITTER	AD	$46.21		$24.90
STONE MASON	AD	$44.30	510	$21.22
TILE & TERRAZZO FINISHER	AD	$28.09		$12.59
TILE & TERRAZZO MECHANIC	AD	$33.41		$14.24
TRUCK DRIVER - DUMP	AD	$17.64	510	$1.92
TRUCK DRIVER - FLATBED	AD	$20.94		$7.63
TRUCK DRIVER - LOWBOY	AD	$29.68	510	$10.51
TRUCK DRIVER - TACK/TAR TRUCK	AD	$27.35	510	$8.97

BALTIMORE COUNTY, MARYLAND

USE OF MINORITY BUSINESS ENTERPRISES AND WOMEN'S BUSINESS ENTERPRISES

IN

COUNTY CONTRACTS

MWBE Plan Package

Division of Diversity, Equity and Inclusion
The Jefferson Building
105 West Chesapeake Avenue
Towson, Maryland 21204
410-887-3407
www.baltimorecountymd.gov/go/mwbe

2032

PROSPECTIVE BIDDERS/OFFERORS

Baltimore County Executive Order 2022-005 Use of Minority Business Enterprises and Women's Business Enterprises states:

SECTION 6. BID REQUIREMENTS.
(A)(l) All bidders shall submit a list of all subcontractors contacted in preparation of their bid package or proposal.
(2) The list shall include the service to be performed, bid amount, and the race/ethnicity/gender of the business owner(s).
(B)(l) All bidders shall submit a list of all subcontractors to be used on a county contract in the bid package.
(2) This list shall include all subcontractors (both MWBE and non-MWBE) used, the service to be performed, the total amount to be paid, and the race/ethnicity/gender of the owner.

If the solicitation includes a MWBE **subcontracting** goal, you **MUST** demonstrate **"Good Faith" effort** either by**:**

1. Complete and sign FORM A, FORM B (to include FORM B-Prime if MWBE Prime wishes to count towards the goal) and FORM C **listing all subcontractors** with the initial bid submission.
    a. *All Forms must be completed and signed. However, FORM C **MUST** be completed and signed by both the prime and the MWBE subcontractor.*

OR

2. If you are unable to meet any portion of the goal, you **MUST** do one of the following**:**

a. If you are requesting a **partial waiver**, complete and sign FORM A with initial bid submission. FORM B (to include FORM B-Prime if MWBE Prime wishes to count towards the goal) and FORM C **(listing all subcontractors**). In addition, complete, sign and submit FORM D and FORM E **accompanied with all supporting documentation** for the portion of the goal that will not be achieved as specified on FORM A.

b. If you are requesting a **full waiver**, complete and sign FORM A indicating your intent to request a full waiver **accompanied with a completed and signed FORM C listing all subcontractors**, FORM D and FORM E **accompanied with all supporting documentation**. **This MUST be submitted with the initial bid as specified on FORM A.**

c. *All Forms must be completed and signed. FORM C and FORM D **MUST** be completed and properly signed **by both** the Prime **AND the MWBE subcontractor(s).***

NOTE: The MWBE **subcontracting** goal applies to **ALL** prime/general contractors including certified and non-certified minority and women owned firms. **However, a Minority-owned or a Women-owned prime may self-perform up to 50% of MWBE subcontracting goal set in the solicitation. The MWBE primes that wish to count towards the goal must list themselves on all appropriate forms.**

12/2023

BALTIMORE COUNTY, MARYLAND
MWBE PARTICIPATION SUMMARY

Executive Order: Minority Business Enterprises and Women Business Enterprises (MWBE) shall have the maximum opportunity to participate in the performance of contracts financed in whole, or in certain circumstances, in part with County funds. Accordingly, on December 6, 2022, the County Executive adopted the EXECUTIVE ORDER No. 2022-005 addressing MWBE participation in County contracts. The December 6, 2022 Executive Order may be found on the Baltimore County website at www.baltimorecountymd.gov/go/mwbe.

Each Contract: The County shall establish a minimum MWBE participation amount for each contract, as applicable.

Bidder/Offeror Responsibility: The bidder/offeror shall ensure that MWBE participation occurs in accordance with the contract requirements and the County Executive's Executive Order. All bidder/offerors shall ensure that MWBE have the maximum opportunity to compete for and perform County contracts, as applicable. Baltimore County, Maryland, and/or its bidder/offerors and contractors shall not discriminate on the basis of race, color, national origin, disability or sex in the award and performance of any County contract.

Mobilization Payments: For subcontractors, project start-up costs can also be significant. A subcontractor that has limited resources and access to credit may find that start-up expenses inhibit its ability to bid County contracts. Under circumstances where mobilization payments are approved for the prime contractor, the subcontractor should be paid an amount equal to their participation percentage no later than five (5) business days before they are required to mobilize to perform the contracted work.

Mobilization costs represent pre-contract costs incurred by a contractor to prepare a job site before the actual commencement of the contract. These costs can include movement of personnel and equipment to the project site and for the establishment of the Contractor's offices, buildings, and other facilities necessary to begin work.

APPROVED MWBE LISTINGS

Published compilations of approved and certified MWBE, contractors, subcontractors, material suppliers, etc. include:

DIRECTORY OF MINORITY BUSINESS ENTERPRISE (MDOT):

https://marylandmdbe.mdbecert.com

MINORITY BUSINESS DIRECTORY OF THE CITY OF BALTIMORE:

https://baltimorecity.diversitycompliance.com

BIDDER/OFFEROR'S ACTIONS

Seeking Firms:

The bidder/offeror will seek commitments by subcontract or otherwise from MWBE firms for supplies and/or services, any combined value of which equals or exceeds the required percentage of MWBE participation goal for the County contract. However a MWBE Prime that affirms its MWBE status on the Minority and/or Women Prime Participation Affidavit may count up to 50% of the goal.

Expenditures for Materials and Supplies:
A bidder/offeror may count toward its MWBE contract requirements all expenditures for materials and supplies obtained from MWBE suppliers and manufacturers, provided that the MWBE firm is furnishing and installing the materials and is certified to perform these services. If the MWBE firm is only being used as a supplier, wholesaler and/or regular dealer or is not certified to install the supplies/materials, for purposes of achieving the MWBE participation goal, you may only count sixty percent (60%) of the value of the subcontract for these supplies/products (60% Rule). To apply the 60% Rule, first divide the amount of the subcontract for these supplies/products only (not installation) by the total Contract value. Then, multiply the result by sixty percent (60%) and insert the percentage in the Percent of Total Contract field of Form B Subcontractor Participation Schedule.

BALTIMORE COUNTY, MARYLAND
MWBE PARTICIPATION SUMMARY

Information to be supplied: All bidder/offerors shall submit the following information to the County at the time of bid submission:

1. The name of an employee designated as the bidder/offeror's liaison to the County's Minority Business Enterprise Office.

2. The following forms shall be completed and submitted:
   - Certified MWBE Utilization and Fair Solicitation Affidavit (**Form A);** from among those names appearing in the Approved MWBE Listings (excepting Federal Highway Administration projects, which exclusively require DBE approved and certified by the Maryland Department of Transportation MBE Advisory Committee);
   - A Subcontractor Participation Schedule (**Form B**) completed by the prime contractor for each MWBE listed on the Form.
   - A MWBE Prime Participation Schedule (Form B-Prime) completed by a MWBE prime contractor if the firm wishes to self-perform up to 50% of the MBE/WBE goal.
   - A MWBE Disclosure and Participation Statement (**Form C**) completed and signed by the prime contractor and MWBE firm for each MWBE listed on the Form. Form C **must match** what is stated on Form B.

   - If applicable, MWBE Subcontractor Unavailable Certificate (**Form D**) completed and signed by the prime contractor and MWBE for each MWBE listed on the Form.

3. If applicable, MWBE Outreach Efforts - Compliance Statement (**Form E**) completed and signed by the Bidder/Offeror. The prime shall submit a list of all subcontractors.

4. For DPW contracts, if the bidder/offeror intends to fulfill the MWBE requirements by use of a joint venture, he/she must submit a Joint Venture Disclosure Affidavit (**Form D-EEO-006-A** and **B** showing the extent of MWBE participation. If a bidder/offeror intends to use a MWBE joint venture as a subcontractor to meet its MWBE requirements, the affidavit must be submitted through the bidder/offeror by the proposed subcontractors and signed by all parties.

5. If the bidder/offeror's proposed MWBE participation does not meet the MWBE contract requirements, information sufficient to demonstrate that the bidder/offeror has made every effort to meet the requirements must be submitted. (See DETERMINATION OF BID RESPONSIVENESS hereafter)

RECORDS AND REPORTS

Returning Records: The bidder/offeror must keep such records as are necessary to determine compliance with its MWBE utilization requirements:

1. The MWBE and non-minority contractors, type of work being performed, actual values of work and services.

2. Documentation of all correspondence, contacts, telephone calls, etc., to obtain MWBE services for the contract.

3. All prime contractors and MWBE sub-contractors are required to report monthly, by the 10th of each month, to the County through an online system called PRISM. If the contractor cannot submit his/her report on time, he/she will notify the County MWBE office and request additional time to submit the report. Failure of the contractor to report in a timely manner may result in a finding of noncompliance. The County in its sole discretion and/or upon written request may require additional reports regarding MWBE. In the event you are not able to enter your payments in PRiSM, a spreadsheet is attached for your use. Please be sure to list the PO for each invoice/ payment reported and include in your submission any corresponding documentation (e.g. copies of invoices or cancelled checks).

Retaining Records: All MWBE records must be retained for 3 years following the expiration or any earlier termination of the contract and shall be available for inspection and photocopying by the County.

Investigation and Notification: Whenever the County believes the bidder/offeror, contractor, or any subcontractor may not be operating in compliance with the MWBE requirements, the County may, in its sole discretion, conduct an investigation. If the County finds the bidder/offeror, contractor, or any subcontractor is not in compliance with the MWBE requirements, the County may exercise any and all rights and remedies available to the County, under the contract, at law or equity, as deemed applicable and appropriate by the County in its sole discretion.

BALTIMORE COUNTY, MARYLAND
MWBE PARTICIPATION SUMMARY

DETERMINATION OF BID RESPONSIVENESS

Request for Deviation: If the bidder/offeror is unable to procure from MWBE firms (by subcontract or otherwise), supplies and services, any combined value of which equals the required percentage of the total value of the contract, the bidder/ offeror may request, in writing, a deviation or waiver of the contract requirements. To obtain such a waiver, the bidder/ offeror must submit the following information at the time bids are due:

1. The request for waiver request shall include (1) a signed unavailability statement (Form D) executed by all MBEs and WBEs that the bidder/offeror solicited for participation and (2) Outreach Efforts/Compliance Statement (Form E) that demonstrates the bidder/offeror's good faith efforts to comply with the contract requirements, including copies of solicitation documentation to all potential subcontractors:

2. Emails, letters, facsimile transmittals and confirmations containing plans, specifications, and anticipated time schedule for portions of the work to be performed and meeting notes and agendas clearly identifying the certified MBE or WBE classification and dates that the bidder/offeror contacted each MWBE; and

3. Telephone logs containing names, addresses, dates, telephone numbers, work to be performed, anticipated time schedule and classification of certified MBEs and WBEs contacted.

Bid Rejection: The failure of any bidder/offeror (including the apparent low bidder/offeror) to provide a responsive MWBE Plan as required by the solicitation may result in the bidder/offeror being deemed non-responsive and the County's rejection of the bid.

Liquidated Damages If the County issues a notice of intent to awards contract to the apparent low bidder/offeror who provided a responsive MWBE Plan, but, if after said notice and before execution of Contract Documents, it is determined by the County that the apparent low bidder/offeror has failed to comply with the MWBE Plan, such failure may result in the recommendation by the appropriate Procurement Official to annul the award and forfeit the bidder/offeror's Proposal Guaranty to the County, not as a penalty, but as liquidated damages, it being acknowledged that actual damages will be difficult if not impossible to accurately measure. In addition, the County may proceed as it determines to be in its best interest, including but not limited to, the Notice of Award may be made to the next lowest responsive and responsible bidder/offeror or the work may be re-advertised.

Contract Breach: If, after execution of a County contract, the contractor becomes aware it may or will fail to fulfill the applicable MWBE requirements and/or may or will deviate from the contractor's bid response/contract terms, the contractor shall promptly advise the County of this in writing. Thereafter, the County will determine what action or remedy is appropriate on a case-by-case basis, in the County's sole discretion.

Approval Required for Changes: Any and all changes to the MWBE subcontractors or the type or amount of work to be performed by such subcontractors during the contract term must be mutually agreeable to the County and the contractor and shall be documented via a contract amendment, executed by legally authorized representatives of the County and the contractor.

Cooperation in Reviews: The bidder/offeror will cooperate with the County in any reviews of the contractor's procedures and practices with respect to MBE or WBE firms, which the County may from time to time conduct in its sole discretion.

Other: If the documents used to determine the contractor's efforts, achievement of, and/or the status of an MWBE requirement or fulfillment thereof contain false, misleading or misrepresented information, the contractor may be declared in breach of the contract and the County may take any and all actions and/or remedies available to the County under the contract, at law, or in equity. If an MWBE is disqualified by any public entity, including but not limited to, Baltimore City, the State or MDOT, at any time after award or during the term of the contract, the County may, in its sole discretion, require the prime contractor to promptly submit for County approval, the contractor's plans for fulfilling the required MWBE participation under the contract, and/or request such detail and additional information as the County, in its discretion deems appropriate.

PRIME CONTRACTOR MINORITY AND WOMEN PARTICIPATION AFFIDAVIT

A. AUTHORIZED REPRESENTATIVE

I HEREBY AFFIRM THAT:

I am the [title]_____and the duly authorized representative of [business]
_____ (the "Business") and that I possess the legal authority to make this Affidavit on behalf of myself and the Business for which I am acting.

B. AFFIRMATION REGARDING MINORITY AND WOMEN PARTICIPATION

I FURTHER AFFIRM THAT:

I am aware that, pursuant to the December 6, 2022 Executive Order of Baltimore County, Maryland, the following words have the meanings indicated.

(A) "Minority Business Enterprise" or "MBE" means a business enterprise that is owned, operated and controlled by one or more minority group members (African American, Hispanic American, Asian American, or Native American) who have at least 51% ownership and in which the minority group members have operational and managerial control, interest in capital and earnings commensurate with their percentage of ownership.

(B) "Women's Business Enterprise" or "WBE" means a business enterprise that is owned, operated and controlled by one or more women who have at least 51% ownership and in which the women have operational and managerial control, interest in capital and earnings commensurate with their percentage of ownership.

____ The Prime is a MBE ☐ or WBE ☐

☐ Maryland State Department of Transportation (MDOT) #_____

☐ City of Baltimore #_____

☐ Name Other Jurisdiction:_____#_____

☐ The ownership of the Noncertified MWBE business consists of___ ___% minorities and ___% women (for a total of____ %), each of which has operational and managerial control, interest in capital and earnings commensurate with their percent ownership.

_____ % African American_____% Hispanic American_____% Women
_____ % Asian American _____% Native American _____% Disadvantaged (DBE)

___The MWBE prime anticipates meeting up to 50% of the stated participation goal with its own workforce. **MWBE primes percentage must be stated on the MWBE PRIME PARTICIPATION SCHEDULE (FORM B-PRIME) to count towards the goal**.

___The prime anticipates ☐ does not anticipate ☐ utilizing subcontractors for_____% of the work of the contract requirements, of which it anticipates_____% will be MBEs and____% will be WBEs.

I DO SOLEMNLY DECLARE AND AFFIRM UNDER THE PENALTIES OF PERJURY THAT THE CONTENTS OF THIS AFFIDAVIT ARE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE, INFORMATION, AND BELIEF.

Date: _____ By:_____
(Authorized Representative and Affiant's Name and Title)

BALTIMORE COUNTY, MARYLAND
Certified MWBE Utilization and Fair Solicitation Affidavit
(FORM A)

This document must be completed and submitted with Bid/Proposal to Baltimore County.

NOTE: If you do not complete and submit this form with your bid or offer to the County, the County may, in its sole discretion, deem your bid or offer NON-RESPONSIVE and accordingly the COUNTY WILL NOT CONSIDER YOU FOR CONTRACT AWARD.

* * * * * * * * * * * * * * *

I acknowledge the goal for solicitation #24111 PP0 is a minimum of 30 %. This goal must be met by any combination of the MWBE subcontractors. However, for instances where the Prime is counting up to 50% of the goal, the remaining goal balance must be met by any combination of the MWBE subcontractors.

- The goal breakdown is as follows:
  - ____% Minority/Women Prime
  - ____ % for certified MBE-owned businesses and/or
  - ____ % for certified WBE-owned businesses.

I have made a good-faith effort to achieve this MWBE solicitation requirement. If awarded the contract, I will comply with this MWBE contract requirement and will continue to use my best efforts to increase MWBE participation during the contract term.

PLEASE CHECK ONE BOX (EITHER 1, 2, OR 3)

1 ☐ Prime has met the MWBE contract requirements for this solicitation and contract. I submit the Subcontractor Participation Form B and Form C, along with this Affidavit, which details how the Prime will achieve the contract requirements. Submit a complete list of all additional subcontractors

Or

2 ☐ After having made a good-faith effort to achieve the MWBE requirements, the Prime can only achieve partial success. I submit the Subcontractor Participation Form B, Form C, Form D and Form E along with this Affidavit, which details how the Prime will partially achieve the contract requirements. Submit a complete list of all additional subcontractors

I request a partial waiver and will meet the following MWBE participation goals:

- Partial waiver of MWBE subcontract participation:
  - ____% Minority/Women Prime
  - ____ % for certified MBE-owned businesses and/or
  - ____ % for certified WBE-owned businesses.

Or

3 ☐ After having made a good faith effort to achieve the MWBE requirements for this contract, the Prime is unable to achieve the requirements and/or sub requirements for this contract. I submit the MWBE Participation Form D and Form E, along with this Affidavit, which details the steps the Prime has taken in an attempt to achieve the contract requirements. Therefore, I request a full waiver.

IF YOU HAVE CHECKED BOX 2 OR 3, THE FOLLOWING IS APPLICABLE:

1) If a bidder is unable to comply with the goals established in a bid for a project, the bidder may submit a request for a waiver at the time of bid submission. However, occasions for granting waivers will be limited.

2) The request for waiver shall include documentation that demonstrates the bidder's good faith efforts to comply with the goals, including:
   a. Signed unavailability statements from all MBEs and WBEs that the bidder solicited for participation; and
   b. Copies of solicitation documentation to include the scope of services to be performed by the subcontractors accompanied with the following:
      i. Emails, letters, facsimile transmittals and confirmations containing plans, specifications, and anticipated time schedule for portions of the work to be performed and meeting notes and agendas clearly identifying the certified MBE or WBE classification and dates that the bidder contacted each; and
      ii. Telephone logs containing names, addresses, dates, telephone numbers, work to be performed, anticipated time schedule and classification of certified MBEs and WBEs contacted.
      iii. Responses from MWBE firms contacted to fulfill the goal.

As I have checked Box 2 or 3 of this Affidavit, I understand I must submit the following supporting documentation with the bid:

- *Subcontractor Participation Schedule* (Form B)
- *MWBE Subcontractor Disclosure and Participation Statement* (Form C)
- *MWBE Subcontractors Unavailable Certificate* (Form D) (if applicable)
- *MWBE Outreach Efforts – Compliance Statement* (Form E) (if applicable)

I acknowledge that the MWBE subcontractors/suppliers listed on the *Subcontractor Participation Schedule* (Form B) will be used to accomplish the percentage of MWBE participation that the Prime shall achieve. A fully executed Form C must match Form B.

In the solicitation of subcontract quotations or offers, MWBE subcontractors were provided the same information and amount of time to respond, as were non-MWBE subcontractors.

The solicitation process was conducted in such a manner so as to not place MWBE subcontractors at a competitive disadvantage to non-MWBE subcontractors.

I solemnly affirm under the penalties of perjury that this Affidavit is true to the best of my knowledge, information, and belief.

Bidder/Offeror Name	Phone Number
Address	Affiant Signature
Address (continued)	Printed Name & Title
E-mail address	Date

BALTIMORE COUNTY, MARYLAND
SUBCONTRACTOR PARTICIPATION SCHEDULE (FORM B)

**This document must be completed and submitted with Bid/Proposal to Baltimore County.*

NOTE: If you do not complete and submit this form with your bid or offer to the County, the County may, in its sole discretion, deem your bid or offer NON-RESPONSIVE and accordingly the COUNTY WILL NOT CONSIDER YOU FOR CONTRACT AWARD.

Prime Name	**Prime Address, Telephone Number and Email**
Bid/Proposal Name and Number	**Project Location**
	Base Bid $_____
1. Subcontractor Name and Tax ID	**Subcontractor Address**
Telephone Number _____ **Email Address** _____ **Select One:** ☐ **MBE** ☐ **WBE** ☐ **SBE** ☐ **N/A** **Provide if Applicable:** ☐ **MDOT** ☐ **Baltimore City** **#**_____	**Minority Status (If applicable):** ☐ **African American** ☐ **Female** ☐ **Asian American Pacific** ☐ **Native American** ☐ **Asian American Sub-continent** ☐ **Hispanic American** ☐ **Supplier, Wholesaler and/or Regular Dealer - 60% Rule**
NAICS Code(s), Work to be Performed and Subcontract Dollar Amount	**Percent of Total Contract (See instructions on Page 1 of the MWBE PARTICIPATION SUMMARY for 60% rule)** _____%
2. Subcontractor Name and Tax ID	**Subcontractor Address**
Telephone Number _____ **Email Address** _____ **Select One:** **MBE** ☐ **WBE** ☐ **SBE** ☐ **N/A** ☐ **Provide if Applicable:** ☐ **MDOT** ☐ **Baltimore City** **#**_____	**Minority Status (If applicable):** ☐ **African American** ☐ **Female** ☐ **Asian American Pacific** ☐ **Native American** ☐ **Asian American Sub-continent** ☐ **Hispanic American** ☐ **Supplier, Wholesaler and/or Regular Dealer - 60% Rule**
NAICS Code(s), Work to be Performed and Subcontract Dollar Amount	**Percent of Total Contract (See instructions on Page 1 of the MWBE PARTICIPATION SUMMARY for 60% rule)** _____%
3. Subcontractor Name and Tax ID	**Subcontractor Address**
Telephone Number _____ **Email Address** _____ **Select One:** **MBE** ☐ **WBE** ☐ **SBE** ☐ **N/A** ☐ **Provide if Applicable:** ☐ **MDOT** ☐ **Baltimore City** **#**_____	**Minority Status (If applicable):** ☐ **African American** ☐ **Female** ☐ **Asian American Pacific** ☐ **Native American** ☐ **Asian American Sub-continent** ☐ **Hispanic American** ☐ **Supplier, Wholesaler and/or Regular Dealer - 60% Rule**
NAICS Code(s), Work to be Performed and Subcontract Dollar Amount	**Percent of Total Contract (See instructions on Page 1 of the MWBE PARTICIPATION SUMMARY for 60% rule)** _____%
Subcontractor Total Dollar Amount $_____	**Total Subcontractor Percent of Entire Contract**_____%
Form Prepared by: **Name/Date:** _____ **Title:** _____ **Email:** _____	**Reviewed and Accepted by Baltimore County Minority Business Enterprise Office** **Name** _____ **Title** _____ **Date** _____

MBE or WBE Prime Participation Total	_____%	$_____
MBE Subcontracting Participation Total	_____%	$_____
WBE Subcontracting Participation	_____%	$_____
Total MWBE Participation	_____%	$_____
Total SBE Participation	_____%	$_____

BALTIMORE COUNTY, MARYLAND

MWBE PRIME PARTICIPATION SCHEDULE
(Form B-Prime)

PLEASE COMPLETE AND SUBMIT THIS FORM TO ATTEST EACH SPECIFIC ITEM OF WORK THAT YOU AS THE MWBE PRIME FIRM WILL PERFORM USING ITS OWN WORKFORCE PERTAINING TO THE PERCENTAGE STATED ON THE SUBCONTRACTOR PARTICIPATION SCHEDULE (FORM B) FOR PURPOSES OF MEETING THE MWBE PARTICIPATION GOALS.

This document must be completed and submitted with Bid/Proposal to Baltimore County.

NOTE: If you do not complete and submit this form with your bid or offer to the County, the County may, in its sole discretion, deem your bid or offer NON-RESPONSIVE and accordingly the COUNTY WILL NOT CONSIDER YOU FOR CONTRACT AWARD.

Provided that _____(Prime Contractor's Name) with Certification Number _____ is awarded the County contract in conjunction with Solicitation No._, such MWBE Prime Contractor intends to count the distinct, clearly defined portion of the work of the contract that the MBE/WBE Prime Contractor performs with its own forces toward fulfilling **up to fifty-percent (50%) of the MWBE participation goal**, at least $_____ which equals to___% of the Total Contract Amount for performing the following products/services for the Contract:

NAICS CODE	WORK ITEM, SPECIFICATION NUMBER, LINE ITEMS OR WORK CATEGORIES (IF APPLICABLE). FOR CONSTRUCTION PROJECTS, GENERAL CONDITIONS MUST BE LISTED SEPARATELY.	DESCRIPTION OF SPECIFIC PRODUCTS AND/OR SERVICES	VALUE OF THE WORK

MWBE PRIME CONTRACTOR

Signature of Representative:

_____

Printed Name and Title:_____

_____

Firm's Name: _____

Federal Identification Number: _____

Address: _____

_____

Telephone:_____

Email Address: _____

Certified Yes ☐ No ☐

Certifying Jurisdiction _____
Date:_____

MWBE PRIME CONTRACTOR

Minority Status:

☐ African American

☐ Hispanic American

☐ Women

☐ Asian American

☐ Native American

Reviewed and Accepted by Baltimore County Minority Business Enterprise Office

Name _____

Title _____

Date _____

Rev 12/2024

BALTIMORE COUNTY, MARYLAND

MWBE SUBCONTRACTOR DISCLOSURE AND PARTICIPATION STATEMENT (FORM C)

This document must be completed and submitted with Bid/Proposal to Baltimore County.

NOTE: If you do not complete and submit this form with your bid or offer to the County, the County may, in its sole discretion, deem your bid or offer NON-RESPONSIVE and accordingly the COUNTY WILL NOT CONSIDER YOU FOR CONTRACT AWARD.

NOTE: ANY INCONSISTENCY BETWEEN THIS FORM AND FORM B *MWBE PARTICIPATION* MAY RENDER A BID/PROPOSAL NON-RESPONSIVE AND THE COUNTY WILL NOT CONSIDER YOU FOR CONTRACT AWARD.

Contract Name, Bid/Proposal Number: _____

Prime Contractor Name: _____

Name of MWBE Subcontractor: _____

_____ _____

Subcontractor Contact Name, Title Subcontractor Email Address

☐ MDOT ☐ Baltimore City

_____

Certification Number

☐ MBE ☐ WBE ☐ SBE ☐ N/A

1. NAICS Code(s), Work/Services to be performed by MWBE Subcontractor: _____

_____

Percent of Total Contract (See instructions on Page 1 of the MWBE PARTICIPATION SUMMARY for 60% rule)

2. Subcontract Amount: $ _____ or _____ % of the County contract cost.

3. Bonds - Amount and type required of Subcontractor if any: _____

4. MWBE Anticipated Commencement Date: _____ Completion Date: _____

Mobilization Cost Amount $_____

5. This is a MBE-Owned Business Firm: Yes _____ No _____

6. This is a WBE-Owned Business Firm: Yes _____ No _____

****

NOTE: If the Prime is notified that it will be awarded the above referenced contract, the undersigned MWBE subcontractor and Prime must enter into a subcontract for the work/service indicated above upon the Prime's execution of a contract for the above referenced project with Baltimore County, and provide a copy of the fully executed MWBE SUBCONTRACTOR PARTICIPATION NOTICE OF INTENT TO AWARD (FORM C-Subcontractor) accompanied with the anticipated Work Breakdown Schedule (providing the subcontractor's mobilization timeframe) to mwbe@baltimorecountymd.gov **within 10 calendar days of receipt by the Prime of FORM C- Subcontractor from the County.** The undersigned subcontractor is an MDOT or Baltimore City certified MWBE firm. The terms and conditions stated above are consistent with our agreements.

Signature of MWBE Subcontractor: _____ Date: _____

Prime's Printed Name and Title: _____ Email: _____

The terms and conditions stated above are consistent with our agreements.

Signature of Prime: _____ Date: _____

Revised 12/2024

BALTIMORE COUNTY, MARYLAND

MWBE –UNAVAILABILITY CERTIFICATE

(FORM D)

If applicable, this document must be completed and submitted with Bid/Proposal to Baltimore County.

NOTE: If you do not complete and submit this form with your bid or offer to the County, the County may, in its sole discretion, deem your bid or offer NON-RESPONSIVE and accordingly the COUNTY WILL NOT CONSIDER YOU FOR CONTRACT AWARD.

1. It is hereby certified that the firm of _____
(Name of Minority firm)

located at _____
(Number) (Street)

_____
(City) (State) (Zip)

was offered an opportunity to bid on the_____contract.

2. The_____(MWBE Firm), is either unavailable for the work/service or unable to prepare a bid for this project for the following reason(s):

_____

_____

_____

_____ _____ _____
Signature of Subcontractor MWBE Representative Title Date

_____ _____ _____
MDOT/Baltimore City Certification # Email Address # Telephone #

3. PRIME'S SIGNATURE AND CERTIFICATION

I certify under oath that I contacted the Certified MWBE and they advised me that they are unavailable, unable to perform the work/services for the above-contract or failed to respond to repeated requests for a price proposal for the above-contract.

_____ _____ _____
Signature of Prime Title Date

Rev 12/2024

BALTIMORE COUNTY, MARYLAND
MWBE - OUTREACH EFFORTS - COMPLIANCE STATEMENT
(FORM E)

This document must be completed and submitted with Bid/Proposal to Baltimore County.

NOTE: If you do not complete and submit this form with your bid or offer to the County, the County may, in its sole discretion, deem your bid or offer NON-RESPONSIVE and accordingly the COUNTY WILL NOT CONSIDER YOU FOR CONTRACT AWARD.

In conjunction with the bid or offer submitted in response to Solicitation Number_____, I state the following:

1. Bidder/Offeror identified opportunities to subcontract in these specific work categories:

   _____
   _____
   _____
   _____

2. Attached to this form are copies of the solicitation documentation in accordance with Section 6 (E) Bid Requirements of the Executive Order, used to solicit certified MWBEs for the subcontract opportunities accompanied with the signed MWBE Subcontractor Unavailability Certificate (Form D).

   _____
   _____
   _____
   _____

3. Bidder/Offeror made the following attempts to solicit MWBEs:

   _____
   _____
   _____
   _____

_____
Signature – Bidder Offeror

_____
Print or Type Name of Firm

_____
Street Address

_____
City State Zip Code

_____
Date

JOHN A. OLSZEWSKI, JR.
County Executive

SEVETRA PEOPLES-BROWN
Executive Director
Chief of Diversity, Equity and Inclusion

To: Contractors/Consultants

From: Minority and Women Business Enterprise Office

Date: December 13, 2024

Subject: Compliance Reporting and Penalties

Baltimore County, Maryland (the "County") requires all Prime Contractors and all Subcontractors to submit payment reports by the 10th of each month through an online MWBE Compliance Portal (PRISM). The Portal can be found under Compliance Reporting for Primes and Subcontractors at www.baltimorecountymd.gov/ go/mwbe. In the event you are not able to enter your payments in PRiSM, a spreadsheet is attached for your use. Please be sure to list the PO for each invoice/ payment reported and include in your submission any corresponding documentation (e.g. copies of invoices or canceled checks).

The County has found that a number of companies are failing to file reports in a timely manner, which makes it difficult for the County to verify compliance. As a result, the County has determined to assess penalties for non-compliance, effective September 1, 2018, as follows:

(a) For failure to file timely monthly reports:
   a. Assessment of a late fee of $10 per day per task, up to a maximum of $1,500 per task; and/or
   b. For multiple violations, termination of the contract for convenience or for default, with the contractor suspended from participating in County contracts for five (5) years.

(b) For failure to meet MWBE requirements:
   a. Assessment of a penalty of up to 10% of the contract value; and/or
   b. Termination of the contract for convenience, with the contractor suspended from participating in County contracts for five (5) years together with assessment of a penalty of up to 10% of the contract value; and/or
   c. Termination of the contract for default together with assessment of a penalty of 10% of the contract value.

Each action and/or remedy described above is at the sole discretion of the County, and is in addition to any damages which the County may be entitled to under the contract.
This short video can be used as guidance on submitting the Prime to Subcontractor Payment Reporting:
http://stage.prismcompliance.com/etc/movies/vendor_contractpayment_tutorial.htm

If after contract expiration, it has been determined the MWBE firms named were not used or were under used, by the contractor and supporting documentation was not provided and approved by the County the contractor may be assessed a penalty of up to 10% of the contract value and/or suspended from participating in County contracts for 5 years.

Questions regarding this correspondence and/or the use of this system can be directed to the MWBE Office at mwbe@baltimorecountymd.gov or call (410) 887-3407.

Attachment: MWBE Payment Report Form
MWBE Payment Acknowledgement Form

Cc: File

S E C T I O N V

POST AWARD DOCUMENTS

This Section to be Completed
by Successful Bidder after Award

CONTRACT AGREEMENT

THIS CONTRACT AGREEMENT ("Contract"), IS MADE THIS _____ day of _____ 20_____, by and between Baltimore County, Maryland, a body corporate and politic ("County"), and _____, ("Contractor").

WITNESSETH, that the Contractor, for and in consideration of the payment or payments herein specified and agreed to by the County, hereby covenants and agrees to furnish and deliver all the materials and to do and perform all the work, services, and labor in fulfillment of the requirements of Contract Number **24111 PP0** "Project") in strict conformity with the solicitation, plans, specifications, special provisions, any and all addenda, and the proposal, at the prices named therein, and all of which are collectively the Proposal, and said Proposal is attached hereto and made a part thereof.

The Project shall be done in strict compliance with (i) the Proposal, (ii) the Baltimore County Department of Public Works and Transportation September 2023 "Standard Specifications for Construction and Materials" and "Standard Details for Construction" (iii) and any and all revisions thereto as of the date of advertisement, including but not limited to the General Conditions Building Projects, as applicable, and all of which (i-iii) are made a part hereof and incorporated herein (collectively, the "Specifications"). Contractor understands and agrees it is Contractor's responsibility and obligation to obtain a copy of the "Specifications" and agrees the Specifications are incorporated herein. Copies are available on the County's website at www.baltimorecountymd.gov/departments/public-works/standards.

The Project shall be subject to the inspection and approval of the Office of Budget and Finance – Property Management for Baltimore County, or his authorized representative, and in the event any portion thereof shall be rejected by said Director or his representative as defective or unsuitable, then the said portion shall be removed and replaced and be performed anew to the satisfaction and approval of the said Director or his representative at the cost and expense of the Contractor.

THE CONTRACTOR AFFIRMS that it is aware of, and will comply with, the provisions of Sections 14-101 through 14-108 of the Election Law Article of the Annotated Code of Maryland, as the same may be amended from time to time, which require that every person who makes, during any 12-month period, one or more contracts, with one or more Maryland governmental entities involving cumulative consideration, of at least $200,000.00, to file with the State Board of Elections certain specified information to include disclosure of attributable political contributions in excess of $500 during defined reporting periods.

THE CONTRACTOR FURTHER COVENANTS AND AGREES that all the Project shall be furnished, performed and delivered, in every respect, to the satisfaction and approval of the Office of Budget and Finance – Property Management, aforesaid, on or before the expiration of **Six Hundred Sixty-Nine (669) CALENDAR DAYS** (the "Contract Period") after written notice has been given by the Director or their authorized representative to begin the work.

IT IS AGREED THAT TIME IS OF THE ESSENCE. In the event the Contractor fails to achieve Final Completion and Final Acceptance of the Contract work within the Contract Period specified herein, plus any extensions thereto agreed to in writing by a legally authorized representative of the County pursuant to the terms of this Contract, then Contractor shall pay the County the sum of **FIFTEEN HUNDRED DOLLARS ($1500.00)** as Liquidated Damages for each **CALENDAR DAY** after the expiration of the Contract Period, as may be extended by the County, until the Contractor achieves Final Completion and Final Acceptance of the Project.

_____

Contractor's Initials

_____

Date

IT IS FURTHER AGREED that:

(a) These Liquidated Damages are a reasonable estimate of the County's damages solely due to the public's loss of use of the Project during the delay period and is not a penalty.

(b) It is very difficult, if not impossible, to accurately measure the damages to the County due to the public's loss of use of the Project during the delay period.

(c) Notwithstanding GP 8.09 of the Baltimore County Standard Specification for Construction, in addition to the damages due to the public's loss of use of the Project during the delay period, the County is likely to incur additional direct costs during the delay period, including but not limited to, costs for construction management, consultants, architectural services, office trailer and supplies, utilities, County employees' time, County vehicles, and such other costs that the County will incur to continue administration of the construction and the Contract during the delay period, all of which will be monitored by the County, and if so required by the County, the Contractor shall pay such actual damages incurred during the delay period. THE PARTIES HERETO UNDERSTAND AND AGREE THAT CONTRACTOR'S OBLIGATION TO PAY THE COUNTY FOR ACTUAL DAMAGES DURING THE DELAY PERIOD SHALL BE IN ADDITION TO THE CONTRACTOR'S OBLIGATION TO PAY THE LIQUIDATED DAMAGES DUE TO THE PUBLIC'S LOSS OF USE OF THE PROJECT.

(d) The County shall have the right, but not the obligation, to deduct the Liquidated Damages due to the public's loss of use of the Project, and the County's actual costs and costs to continue administration of the construction and the Contract, from any monies due or any monies that may become due to the Contractor.

IT IS DISTINCTLY UNDERSTOOD AND AGREED that no claim for extra work, material or overhead not specifically provided for in the Contract will be allowed by the County, nor shall the Contractor do any work or furnish any materials not covered by this Contract and the Specifications, unless the same is ordered in writing by a legally authorized representative of the Office of Budget and Finance – Property Management in accordance with the terms of the Contract. Any such work or materials which may be done or furnished by the Contractor without any such written order first being given shall be at said Contractor's sole risk, cost and expense and Contractor hereby covenants and agrees that without such written order, Contractor shall make no claim for compensation for work, materials, or overhead so done or furnished.

NOTWITHSTANDING GP 4.06 OF THE BALTIMORE COUNTY STANDARD SPECIFICATIONS FOR CONSTRUCTION, IT IS SPECIFICALLY AGREED that the Contractor shall have no entitlement to damages arising out of delay, disruption, interference or hindrance from any cause whatsoever. However, this provision shall not preclude recovery or damages by the Contractor for hindrances or delays due solely to fraud or gross negligence on the part of the County or its agents.

IT IS FURTHER DISTINCTLY AGREED that the said Contractor shall not assign this Contract, nor any part thereof, nor any right to any of the monies to be paid hereunder, nor shall any part of the work to be done or material furnished under said Contract be sublet without the prior written consent of a legally authorized representative of the Office of Budget and Finance – Property Management in accordance with the terms of this Contract. Further, the acceptance of the final payment by the Contractor shall effectuate a release in full of all claims against County and its officials, employees, representatives, and agents arising out of, or by reason of the Project and this Contract.

The Contractor shall review government issued identification and badge all employees of the Contractor and its subcontractors. The Contractor shall also review all federal forms, including but not limited to I-9's, for compliance as well as copies of all employment eligibility and identity documentation maintained to the extent required by law.

The Bonds, given by the Contractor in a sum equal to the total contract price of the Project in compliance with the terms and provisions of this Contract, are hereby attached and incorporated herein.

IT IS AGREED that in the event that the County is delayed or prevented from timely execution of this Contract, the Contractor releases County and agrees Contractor shall have no action, claim or demand against County therefore.

Contractor's Initials

Date

THE CONTRACTOR HEREBY FURTHER AGREES to receive the prices set forth in the Proposal incorporated herein as full compensation for the completion of the Project and, in all respects, to complete said Contract to the satisfaction of the County.

THE CONTRACTOR REPRESENTS AND WARRANTS:

(i) it is duly formed and validly existing under the laws of the State of _____;

(ii) it is in good standing in the State of Maryland;

(iii) it has the power and authority to consummate the obligations and responsibilities contemplated hereby, and has taken all necessary action to authorize the execution, delivery and performance required under this Contract;

(iv) the Contractor and the person executing this Contract for the Contractor each warrant that he/she is duly authorized by the Contractor to execute and seal this Contract on the Contractor's behalf;

(v) the warranties of merchantability and fitness for a particular purpose and use and warranties of title and against infringement, and all express warranties contained in this Contract, including but not limited to the Proposal (and any sample or model presented by Contractor and expressly accepted by the County) shall apply to the portion of this Contract pertaining to or for goods;

(vi) all representations and warranties made in the Proposal and herein remain true and correct in all respects when made, as of the date of this Contract, and throughout the term of this Contract; and

(vii) there exists no actual or potential conflict of interest between its performance under this Contract and its engagement or involvement in any other personal or professional activities and in the event such conflict or potential conflict arises during the term of this Contract, the Contractor shall immediately advise the County in writing thereof.

THE CONTRACTOR shall not disclose any documentation and information of any kind or nature disclosed to the Contractor in the course of its performance of duties hereunder without the express prior written consent of the County.

Those sections in this Contract which by their nature are intended to survive, including but not limited to, Contractor's representations and warranties, confidential information, and indemnification shall survive the termination of this Contract.

IN WITNESS WHEREOF, the Contractor has hereunto set its hand and seal the day and year first above written.

CONTRACTOR NAME: _____

WITNESS

FEDERAL TAX ID or SS #: _____

_____

By: _____ (Seal)

_____
Type (Print) Name

Name: _____

Title: _____ Date: _____

WITNESS:

BALTIMORE COUNTY, MARYLAND

_____
Executive Secretary

By: _____ Date: _____
D'Andrea L. Walker, County Administrative Officer

_____
Type (Print) Name

APPROVED FOR FORM AND LEGAL AND SUFFICIENCY* (Subject to execution by the duly authorized Administrative official and Chairperson of the County Council, as indicated).

APPROVED:

_____ Date: _____
Kevin D. Reed, Director
Office of Budget and Finance

_____
Office of the County Attorney

*Approval of Form and Legal Sufficiency does not convey approval or disapproval of the substantive nature of this transaction. Approval is based upon typeset documents. All modifications require re-approval.

Rev. 09/2024

P E R F O R M A N C E B O N D Bond No._____

Principal	**Business Address of Principal**
Surety	**Obligee:** **BALTIMORE COUNTY, MARYLAND** A body corporate and politic

A Corporation of the State of _____ and authorized to do business in Maryland

Penal Sum of Bond (express in words and figures) DOLLARS $_____	
Wilkens Police Precinct New Building	_____ **20** _____
Contract Name	**Date of Contract**
24111 PP0	_____ **20** _____
Contract Number	**Date Bond Executed**

KNOW ALL MEN BY THESE PRESENTS, that we, the PRINCIPAL, above-named, and SURETY, above-named, and authorized to do business in the State of Maryland, are held and firmly bound unto the OBLIGEE, above-named, in the penal sum of the amount stated above, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, THE PRINCIPAL entered into a certain contract with the OBLIGEE described and dated as shown above and is required to provide this bond pursuant to Maryland State law and/or County law and the contract.

NOW, THEREFORE, if the aforesaid PRINCIPAL shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the OBLIGEE with or without notice to the SURETY, and during the life of any guaranty required under the contract, and shall also well and truly perform and fulfill all the undertakings covenants, terms, conditions and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the SURETY being hereby waived, then, this obligation to be void; otherwise to remain in full force and effect.

THE SURETY FURTHER GUARANTEES That it is (a) licensed in the State of Maryland, (b) rated "B" or better by the A.M. Best Company, (c) on federal funded projects, authorized by the underwriting limitation contained in the U.S. Department of the Treasury Circular 570, as amended, to guaranty the amount of the Bid, and (d) in good standing as determined by the County's Engineer. A Performance Bond is required for each and every Contract in excess of twenty-five thousand ($25,000). A Performance Bond shall be in the amount equal to at least one hundred (100%) percent of the Contract price. The fully executed Performance Bond shall be delivered by the Bidder to the Department's Division of Construction Contracts Administration no later than the time the Contract is to be executed by the Contractor.

IN WITNESS WHEREOF, the above-bounded parties have executed this instrument under their several seals on the date indicated above, the name and seal of each party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

In Presence of: **Individual Principal**

Witness: _____ **as to:** _____ **(SEAL)**

Print Name: _____ **Print Name:** _____

Attest: **Corporate Principal**

_____
(Name of Corporation)

Witness: _____ **By:** _____ Affix

Print Name: _____ **Print Name:** _____ Corporate

Title: _____ Seal

Attest: **Surety**

_____
(Name of Surety)

Business Address: _____

Witness: _____ **By:** _____ Affix

Print Name: _____ **Print Name:** _____ Corporate

Title: _____ Seal

Reviewed for Baltimore County Requirements

_____
Office of the County Attorney

Revised
February 4, 2015

PAYMENT BOND

Bond Number_____

Principal | **Business Address of Principal**

Surety

Obligee: **BALTIMORE COUNTY, MARYLAND**
A body corporate and politic

A Corporation of the State of _____ and authorized to do business in Maryland

Penal Sum of Bond (express in words and figures) DOLLARS $_____

Wilkens Police Precinct New Building
Contract Name

_____ **20** _____
Date of Contract

24111 PP0
Contract Number

_____ **20** _____
Date Bond Executed

KNOW ALL MEN BY THESE PRESENTS, that we, the PRINCIPAL, above-named, and SURETY, above-named, and authorized to do business in the State of Maryland, are held and firmly bound unto the OBLIGEE, above-named, in the penal sum of the amount stated above, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, THE PRINCIPAL entered into a certain contract with the OBLIGEE described and dated as shown above and is required to provide this bond pursuant to Maryland State law and/or County Law and the contract.

NOW, THEREFORE, the condition of this obligation is such that if the aforesaid PRINCIPAL shall promptly make payments to all persons supplying labor and/or material to the PRINCIPAL and to any subcontractor of the PRINCIPAL in the prosecution of the work provided for in said contract and any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the SURETY being hereby waived, then, this obligation to be void; otherwise to remain in full force and effect.

THE SURETY FURTHER GUARANTEES That it is (a) licensed in the State of Maryland, (b) rated "B" or better by the A.M. Best Company, (c) on federal funded projects, authorized by the underwriting limitation contained in the U.S. Department of the Treasury Circular 570, as amended, to guaranty the amount of the Bid, and (d) in good standing as determined by the County's Engineer. A Payment Bond is required for each and every Contract in excess of twenty-five thousand ($25,000). A Payment Bond shall be in the amount equal to at least one hundred (100%) percent of the Contract price. The fully executed Payment Bond shall be delivered by the Bidder to the Department's Division of Construction Contracts Administration no later than the time the Contract is to be executed by the Contractor.

IN WITNESS WHEREOF, the above-bounded parties have executed this instrument under their several seals on the date indicated above, the name and seal of each party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

In Presence of: **Individual Principal**

Witness: _____ **as to:** _____ **(SEAL)**

Print Name: _____ **Print Name:** _____

Attest: **Corporate Principal**

_____
(Name of Corporation)

Witness: _____ **By:** _____ Affix

Print Name: _____ **Print Name:** _____ Corporate

Title: _____ Seal

Attest: **Surety**

_____
(Name of Surety)

Business Address: _____

Witness: _____ **By:** _____ Affix

Print Name: _____ **Print Name:** _____ Corporate

Title: _____ Seal

Reviewed for Baltimore County Requirements

_____Office of the County Attorney

Revised
February 4, 2015

BALTIMORE COUNTY, MARYLAND

INSURANCE PROVISIONS

1. **GENERAL REQUIREMENTS**

1.1 Coverages Required:
Unless otherwise required by the specifications or the contract, the Contractor/Vendor shall purchase and maintain the insurance coverage's listed herein.

1.2 Certificate of Insurance:
Before starting work on the contract, or prior to the execution of the Contract on those bid, the Contractor/Vendor shall provide Baltimore County, Maryland with verification of insurance coverage evidencing the required coverages.

1.3 Baltimore County as Insured:
The coverage required, excluding Workers' Compensation and Employers' Liability and Medical Malpractice Liability/Professional Liability/Errors and Omissions Liability, must include Baltimore County, Maryland and its agents, employees, officers, directors, and appointed and elected officials as an additional insured.

1.4 Contractor's/Vendor's Responsibility:
The providing of any insurance herein does not relieve the Contractor/Vendor of any of the responsibilities or obligations the Contractor/Vendor has assumed in the contract or for which the Contractor/Vendor may be liable by law or otherwise.

1.5 Failure to Provide Insurance:
Failure to provide and continue in force the required insurance shall be deemed a material breach of the contract. The Contractor/Vendor must maintain the insurance coverages required under the terms and conditions on this Contract while this Contract is in effect including renewal and extension terms.

2. **INSURANCE COVERAGES**

2.1 General Liability Insurance

2.1.1 Minimum Limits of Coverage:
Personal Injury Liability and Property Damage Liability
Combined Single Limit - $500,000 each occurrence.

2.1.2 Such insurance shall protect the Contractor/Vendor from claims which may arise out of, or result from, the Contractor's/Vendor's operations under the contract, whether such operations be by the Contractor/Vendor, any subcontractor, anyone directly or indirectly employed by the Contractor/Vendor or Subcontractor, or anyone for whose acts any of the above may be liable.

2.1.3 Minimum Coverages to be Included:
(a) Independent Contractor's coverage;
(b) Completed Operations and Products Liability coverage;
(c) Contractual Liability coverage.

2.1.4 Damages not to be Excluded:
Such insurance shall contain no exclusions applying to operations by the Contractor/Vendor or any Subcontractor in the performance of the Contract including but not limited to:
(a) Collapse of, or structural injury to, any building or structure;
(b) Damage to underground property; or
(c) Damage arising out of blasting or explosion.

2.2 Automobile Liability Insurance

2.2.1 Minimum Limits of Coverage:
Bodily Injury Liability and Property Damage Liability
Combined Single Limit - $500,000 any one accident.

2.2.2 Minimum Coverages to be Included:
Such insurance shall provide coverage for all owned, non-owned and hired automobiles.

2.3 Workers' Compensation and Employers' Liability Insurance

Such insurance must contain statutory coverage, including
Employers' Liability insurance with limits of at least:
Bodily Injury by Accident - $250,000 each accident
Bodily Injury by Disease - $500,000 policy limit
Bodily Injury by Disease - $250,000 each employee

2.4 Valuable Papers and Records Coverage and Electronic Data Processing (Data and Media) Coverage

Minimum Limits of Coverage:
$100,000 Per Claim and Each Occurrence
$100,000 in the Aggregate

2.5 Other

Such other insurance in form and amount as may be customary for the type of business being under taken by the Contractor/Vendor.

2.6 Builder's Risk

See Special Provisions page 2004 and General Conditions page 34,35, Article 33.