SMOLEN • EMR • ILKOVITCH ARCHITECTS

Project Number: 23010

Bid Specifications

Volume 1 of 1

April 8, 2024

Leonardtown High School

Concessions Building

New Construction

23995 Point Lookout Rd
Leonardtown, MD 20650

St. Mary's County Public Schools

St. Mary's County Public Schools

9211 Corporate Blvd, Suite 340, Rockville, Maryland ▪ p: 301-770-0177 ▪ f 301-330-3224 ▪ www.SElarch.com

PROJECT DIRECTORY

LEONARDTOWN HIGH SCHOOL CONCESSIONS BUILDING

Leonardtown, Maryland

ST. MARY'S COUNTY PUBLIC SCHOOLS

ARCHITECT:

SMOLEN ▪ EMR ▪ ILKOVITCH Architects
9211 Corporate Blvd, Suite 340
Rockville, Maryland 20850
301-770-0177 (P) 301-330-3224 (F)

Ran Ilkovitch, NCARB, AIA, Principal-in-Charge
Brian McCracken, AIA, CPD, Project Architect
Patrick Newton, Architecture Staff

CIVIL ENGINEER:

COA Barrett
100 Jibsail Dr
Prince Frederick, MD 20678
410-257-2255 (P)

Joseph J. Kadjeski, PE, Principal Engineer
Martin Elzy, Drafting Technician

MECHANICAL, ELECTRICAL, PLUMBING & FIRE PROTECTION ENGINEER:

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303 International Circle, Suite 450
Hunt Valley, MD 21030
410-842-6411 (P)

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Sergio Esquivel, PE, Project Manager
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Brayden J. Borromeo, Mechanical Engineer
Mahsa Zarrindast, CADD/Revit Technician
Dave Yates, LC, IES, Lighting Designer

STRUCTURAL ENGINEER:

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9220 Wightman Rd, Suite 120
Montgomery Village, MD 20886
240-200-5599 (P)

Stacy E. Rogers, PE, Principal

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Project Manual
For

Leonardtown High School
Concessions Building

Leonardtown, Maryland

SMCPS-2024-10-DSS-DC

Commissioned by:

St. Mary's County Public Schools
23160 Moakley Street
Leonardtown, Maryland 20650

Phone: (301) 475-4256

Mrs. Karin M. Bailey, Chairman
Mrs. Cathy Allen, Vice Chairman
Mrs. Mary Washington, Member
Mr. James J. Davis, Member
Mrs. Dorothy Andrews, Member
Ms. Manasa Iswara, Student Member
Dr. J. Scott Smith, Secretary/Treasurer and
Superintendent of Schools

Mr. Alex Jaffurs, Ed. D., Assistant Superintendent of Supporting Services
Ms. Paola Laino, Assoc. AIA, Director of Design and Construction
Mr. Todd Whitlock, CDT, Project Management Coordinator II

Prepared By:
St. Mary's County Public Schools
Department of Design and Construction
27190 Point Lookout Road
Loveville, Maryland 20656

April 8, 2024

Stadium Concession Stand Replacement at
Leonardtown High School
RFP# SMCPS-2024-10-DSS-DC
8 April 2024

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SECTION A
GENERAL INTENT AND SCOPE

A.1 GENERAL INTENT

It is the intention of the Board of Education of St. Mary's County, Maryland, (hereinafter referred to as the "Owner"), to procure the Work set forth in the Contract Documents identified herein, which is generally described in paragraph A.2 below, complete and ready for use. The Contractor shall accomplish all Work, including additional, extra and incidental work that may be considered necessary by the Owner to complete the project in a satisfactory and acceptable manner, and shall furnish all plant, equipment, tools, materials, labor and incidentals necessary to carry on the project to satisfactory completion within the time period specified and in strict accordance with the Contract Documents and requirements, including but not limited to the specifications.

A.2 GENERAL SCOPE

The Work under the Contract includes all work identified in the Contract Documents and is generally described as the construction of a new 2,100 SF one-story outbuilding with masonry bearing walls and a wood truss roof. The Area of Work includes the new structure and associated sitework. The building will include a Concessions room, storage, restrooms and, under Alternate #1, a Team Room. Under Alternate #2, an extended overhang above the serving windows will be added.

A.3 TIME FOR COMPLETION

The Contractor shall commence work under the Contract within ten (10) calendar days of the date of the Owner's Notice to Proceed. Contractor shall follow through and prosecute the Owner's work diligently until completion. Subject to authorized adjustments, the Contractor shall fully complete the Work within **one hundred eleven days (111)** calendar days of commencement of Work, at which point in time the project will be in a finished condition, as specified, all temporary buildings, equipment, tools, and surplus and waste materials will have been removed from the job site, and all close-out requirements of the Contract shall have been satisfied. TIME IS OF THE ESSENCE UNDER THE CONTRACT. All work must be completed by **September 20, 2024.**

*****END OF SECTION****

SECTION B

INSTRUCTIONS TO BIDDERS

B.1 BIDS

Only those Contractors who prequalified to bid in accordance with SMCPS's Request for Qualifications and Prequalification Process are eligible to submit a construction bid for the Project as listed herein. Any Contractors who submit construction bids without having prequalified shall be deemed non-responsible bidders and any bid submitted without prequalification in accordance with the prequalification process shall be deemed non-responsive for the Contractor's failure to prequalify.

Sealed bids will be received by the Board of Education of St. Mary's County, Department of Design and Construction, 27190 Point Lookout Road, Loveville, MD 20656, until **April 29, 2024** at **1:00 p.m.**, at which time the bids will be reviewed for a recommendation to award to the apparent low bidder. TIME IS OF THE ESSENCE UNDER THE BIDDING DOCUMENTS. Each bid proposal shall be submitted on the Proposal Form provided by the Owner with this Solicitation. Bids shall be submitted without interlineations, alterations, or erasures. Bids shall not contain exclusions of any portion of the Work or other requirements of the Bidding Documents. Any exclusion shall render the bid non-responsive.

The outside of the envelope shall be clearly marked "**Stadium Concession Stand Replacement**". Timely delivery is the responsibility of the submitting contractors. Late Applications will not be considered unless deemed by SMCPS, in its sole discretion, to be in its best interest. Because of the rural location of the SMCPS, Federal Express will not guarantee delivery to SMCPS by any specific time. It is the Contractor's responsibility to confirm delivery of their submission via email to Vivian Johnston, Contract & Fiscal Specialist at vajohnston@smcps.org .

B.2 PRE-BID CONFERENCE

All Bidders are encouraged to attend a pre-bid conference. Prospective Bidders may assemble at Leonardtown High School located at 23995 Point Lookout Road, Leonardtown, MD 20650, on **Thursday, April 11, 2024, at 9:30a.m.** Please email your intent to attend this conference directly to Mr. Todd Whitlock, CDT, Project Management Coordinator II at tgwhitlock@smcps.org.

B.3 BID SECURITY

When the base bid total equals or exceeds $50,000, each bid must be accompanied by bid security in the form of:

A. A cashier's check or certified check of the bidder, payable to the Owner; or

B. Two (2) certified copies of a bid bond from a Surety Company acceptable to the Owner, submitted on St. Mary's County Public Schools Attachment C, Section 004313.

The bid security shall be properly executed in favor of the Owner for not less than five (5%) percent of base bid. For base bid totals less than $50,000.00, no bid security is required.

Acceptable surety companies are those with claims offices in the State of Maryland, licensed by the Maryland Insurance Administration and with an "A-" or better rating in the Best's Key Rating Guide.

The proceeds of the bid security will be forfeited to the Owner as liquidated damages and not as penalty if the bidder fails to execute and return the Contract, and/or fails to deliver a properly executed Performance Bond and Payment bond, if required, under Section E.1, within ten (10) calendar days of the date of Notice of Contract Award.

B.4 CONTRACT DOCUMENTS

Proposed Contract Documents, including Drawings, must be requested from Vivian Johnston, Contract and Fiscal Specialist, at vajohnston@smcps.org. Drawings will be available beginning **April 08, 2024** during normal office hours 8:00 a.m. – 3:30 p.m. Drawings will not be available after the request for information (RFI) deadline.

B.5 INSPECTION OF THE SITE

Bidders are required to examine the bidding and Contract Documents, to visit and inspect the site, to acquaint themselves with all governing laws, ordinances, etc. that may apply to or affect the work, and to take such other steps as are reasonably necessary to ascertain the nature, location and extent of the work, and the general and local conditions which may affect the work or the cost and/or time of performance thereof. The act of submitting a bid shall be considered a representation by the Bidder that the Bidder has satisfied these requirements. Failure to do so will not relieve bidders from responsibility for properly estimating the difficulty, cost, or timing or requirements of successfully performing the work. Bidders shall promptly notify the Owner of any ambiguity, inconsistency, or error that they discover upon examination of the bidding and Contract Documents or of the site and local conditions. **Arrangements for site visits must be made by calling Todd Whitlock, CDT, Project Management Coordinator II, at (301) 475-4256, ext. 34168.**

B.6 EXPLANATION TO PROSPECTIVE BIDDERS

Any prospective bidder desiring an explanation or interpretation of the solicitation, specifications, etc. (RFI), must request such in writing a minimum of two (2) calendar days prior to the bid date to allow a reply to reach all prospective bidders before the submission of their bids. Electronic mail (e-mail) does qualify as a written request and is preferred. The Owner will have no liability or responsibility for any oral statements or representations made by any of its officers or agents prior to the bid opening. **The deadline for RFI's is April 24, 2024, at 12:00 noon.**

B.7 BID SUBMISSION

All bids must be submitted according to section B.1. There are no exceptions. Bids submitted in any other manner (fax, etc.) will not be considered. The bid shall be submitted with:

a) The bid security specified in Section B.3 above (if applicable);

b) The affidavit of eligibility specified in Section B. 10 below; and

c) Any other documents required to be submitted with the bid (as otherwise specified herein).

The failure to submit any one or more of these documents with the bid (when required) will result in a determination that the bid is non-responsive. Bidders shall submit their bid in duplicate on the Proposal Form contained in Section D. The Proposal Form shall be filled in completely, with the bid amounts shown in letters opposite each item and immediately followed in figures. The Proposal Form shall be submitted by a duly authorized representative of the Bidder.

B.8 NO BID CAN BE WITHDRAWN

No bid can be withdrawn after it is filed unless a bidder makes its request in writing to the Owner and such request is received before the time set for the opening of bids.

B.9 (NOT APPLICABLE)

B.10 §16-311 STATE FINANCE AND PROCUREMENT ARTICLE AFFIDAVIT

A person convicted of bribery, attempted bribery, or conspiracy to bribe shall be disqualified from entering into a Contract with any public body.

Bidders must complete and submit with their bid an affidavit in the attached form that the bidder is eligible to enter into a contract under §16-311 of the State Finance and Procurement Article of the Annotated Code of Maryland. The failure to submit a completed affidavit with the bid will result in a determination that the bid is non-responsive.

Every person or entity submitting a bid or otherwise applying for a Contract shall submit an affidavit stating to its best knowledge whether the bidder or any of its officers, directors, or partners, or any of its employees who are directly involved in obtaining or performing contracts with any public bodies has:

(1) been convicted of bribery, attempted bribery, or conspiracy to bribe, under the laws of any state or of the federal government;

(2) been convicted under a State or federal law or statute of any offense enumerated in § 16-203 of the State Finance and Procurement Article of the Annotated Code of Maryland; or

(3) been found civilly liable under a State or federal antitrust statute as provided in § 16-203 of the State Finance and Procurement Article of the Annotated Code of Maryland

The affidavit shall also contain the bidder's affirmation that it shall not knowingly enter into a contract with a public body under which a person or business 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.

B.11 MARYLAND SEX OFFENDER CERTIFICATION

Bidders are advised that Maryland law provides the following prohibitions against registered sex offenders performing work or services on school system property:

"A person who enters a contract with a county board of education or a nonpublic school may not knowingly employ an individual to work at a school if the individual is a registrant. A person who violates this section is guilty of a misdemeanor and upon conviction is subject to imprisonment not exceeding 5 years or a fine not exceeding $5,000 or both."

Within ten (10) working days from notification that the bidder is the apparent low Bidder, or from Notice of Award, whichever is sooner, the successful bidder must submit a certification to the Owner that no employee, subcontractor, subcontractor employee, or material supplier that is a registered sex offender will be allowed to enter onto school system property at any time in the performance of the work or services for which the contract is awarded. Such certification is a condition precedent to any contract award, and the failure to so certify will be grounds for not awarding a contract.

It will be the responsibility of all contractors to obtain similar certifications from all subcontractors, suppliers and vendors delivering materials, equipment or supplies to school system property, and/or performing work or services on school system property, and to monitor adherence to this requirement. In the event that the Owner determines that a registered sex offender has entered upon school property for a delivery of materials, equipment or supplies and/or for the performance of work or services under the contract, such will be grounds for termination of the contract. This provision shall be incorporated verbatim into all contracts and subcontracts for work and services performed for the Board of Education of St. Mary's County.

B.12 CONSIDERATION OF BIDS

The Owner reserves the right to:

A. Award the Contract to the lowest responsive and responsible bidder, who, in the sole discretion of the Owner, is qualified as to financial responsibility and ability to properly execute the work called for in this solicitation.

B. Reject any or all bids with or without cause or explanation, for any reason, including but not limited to the Owner's own convenience.

C. Waive any minor defects, irregularities or informalities in the bids.

D. Select one or more, or none of the Alternates, if any, identified in the solicitation for inclusion in the Contract, and to select Alternates in any order. The selection of Alternates shall be in the sole discretion of the Owner.

B.13 BID PROTESTS

Interested parties may protest a decision of SMCPS by submitting a protest in writing to the Superintendent of Schools, St. Mary's County Public Schools, 23160 Moakley Street, Leonardtown, Maryland 20650 within ten (10) calendar days of the decision. A complete copy of the protest and all supporting documentation must also be submitted within ten (10) calendar days of the decision to the Division of Supporting Services, Department of Design and Construction, St. Mary's County Public Schools, 27190 Point Lookout Road, Loveville, Maryland 20656. SMCPS and the Board may deny untimely protests.

The protest shall identify the decision being protested, and the Project for which the decision was made. The written protest shall specify the grounds for the protest and

shall include a detailed statement of the factual and legal basis for the protest, including:

a. The name, address, and telephone number of the protestor
b. The relevant facts relied upon for the protest
c. Any language from the Request for Proposal relied upon for the protest
d. Any information contained in the Contractor's technical or price proposals relied upon for the protest
e. Citation of any rules, regulations, case law, statutes or other legal authority relied upon for the protest
f. Any other information relied upon for the protest

The written protest shall also include copies of all documents, data, records or other evidence relevant to the protest. The burden of producing the foregoing information, documents, data, records and other relevant evidence is on the protestor. The burden of persuasion on the merits of the protest is also on the protestor.

A decision on the protest, and appeals thereof, shall be made in accordance with the requirements of Section 4-205(c) of the Education Article of the Annotated Code of Maryland. Upon receipt of a timely and complete written protest, an initial determination on the protest shall be made by the Superintendent of SMCPS or his/her designee. The decision of the Superintendent may be appealed to the Board, if taken within thirty (30) days after the date of the Superintendent's decision. The decision of the Board may be further appealed to the State Board of Education if taken in writing within thirty (30) days after the decision of the Board.

*****END OF SECTION****

SECTION C

ALTERNATES

C.1 DESCRIPTION OF REQUIREMENTS

A. An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted. Bidders are required to clearly indicate whether each Alternate Bid increases, decreases or has no effect on the base bid amount.

B. General Requirements: The requirements of the Contract Documents (including the General Conditions, Special Conditions, Specifications, etc.) apply to work identified in the Alternate bids accepted by the Owner and included in the Contract.

C. The Contractor is required to coordinate all accepted alternates with related contract Work, and to modify or adjust any adjacent or related work as required to ensure that work affected by each accepted alternate is complete and fully integrated into the project. The cost of all such coordination, modifications and/or adjustments shall be included in the Alternate Bid amount.

D. Schedule: A "Schedule of Alternates" is included at the end of this section. Specification section(s) relating to the alternate may be referenced in the schedule for convenience only. Bidders are advised to review all specifications and other Contract Documents prior to bidding to confirm any requirements for materials and methods necessary to achieve the work described under each alternate.

E. Bidders are required to include as part of each alternate bid amount, the cost of all miscellaneous devices, appurtenances and similar items incidental to or required for a complete installation whether or not described as part of the alternate.

C.2 DESCRIPTION OF ALTERNATES

A. Finished Team Room

B. Extended overhang above the serving windows

*****END OF SECTION*****

SECTION D

BOARD OF EDUCATION OF ST. MARY'S COUNTY
ST. MARY'S COUNTY PUBLIC SCHOOLS

PROPOSAL FORM

Having requested from St. Mary's County Public Schools, and carefully examined the Contract Documents for the **Stadium Concession Stand Replacement at Leonardtown High School**, **SMCPS-2024-10-DSS-DC**, and after having visited the site and examined all conditions affecting the work and having received all addenda and written clarifications to the bidders from the Owner, the undersigned hereby agrees if this bid is accepted to enter into a contract with the Owner (in the form included in the Contract Documents) and to perform the work and furnish all plant, labor, materials, supplies, equipment, other facilities, profit, and overhead necessary and proper for the completion of the project as required by and in strict accordance with the Contract Documents and to the complete the Work to the satisfaction of the Owner, for the stipulated lump sum(s) of:

Total Base Bid Price: _____$_____
(Defined in written words)

Alternate No. One:
Add: _____ Dollars $_____

Alternate No. Two:
Add: _____ Dollars $_____

In submitting this BID, Bidder represents, as set forth in the Bidding Documents that Bidder has examined copies of all the Contract Documents and the following Addenda:

DATE	ADDENDA NUMBER
_____	_____
_____	_____
_____	_____

Name of Bidder: _____

Address: _____

City, State, Zip Code: _____

Phone No.: _____

Email: _____

Signature: _____
Authorized Representative of Bidder

Printed Name: _____

Date Submitted: _____

By its submission of this bid, the undersigned agrees that in the event it is selected for Contract Award by the Owner, it shall be bound to Owner with respect to post contract award submission requirements set forth in the Solicitation for this Project.

*****END OF SECTION****

SECTION E

CONTRACT AWARD - PERFORMANCE AND PAYMENT BONDS

E.1 If the total contract amount exceeds $50,000.00, the successful bidder shall be required to deliver to the Owner a Performance Bond and a Payment Bond written on **ST. MARY'S COUNTY PUBLIC SCHOOLS FORMS** and properly executed by an acceptable surety company, each in the amount of one hundred percent (100%) of the respective Contract amount. Acceptable surety companies are those with claims offices in the State of Maryland, licensed by the Maryland Insurance Administration and with an "A-" or better rating in the Best's Key Rating Guide. Copies of bond forms are attached to this document.

E.2 The Contractor shall, within ten (10) days of the date of Notice of Award, execute and deliver to the Owner: (1) the executed Contract; (2) the Performance and Payment Bonds if required; and (3) satisfactory evidence of all required insurance coverage identified in the General Conditions of the Contract.

E.3 Failure on the part of the Contractor to execute and deliver the executed Contract and the Performance and Payment Bonds, if required, and to furnish evidence of insurance required in Article E.2 above, within ten (10) days after the date of the Notice of Award, shall be just cause for the annulment of the award and the forfeiture of the bid security to the Owner, which forfeiture shall be considered not as a penalty, but in liquidation of damages sustained. Award may then be made to the next lowest responsive and responsible bidder, or all bids may be rejected, and the Contract re-advertised.

SUBMISSION OF POST AWARD INFORMATION

E.4 The selected Contractor shall within seven (7) days after the Notice of Award submit the following:

A. A designation of the work to be performed by the Contractor with its own forces.

B. A list of names of the subcontractors, and materials and equipment vendors proposed for the principal portions of the work. The Contractor will be required to establish, to the satisfaction of the Owner, the reliability and responsibility of the proposed subcontractors, equipment and material vendors, and its own work forces, to furnish and perform their designated work. If the Owner objects to and refuses to accept any person or organization on the list, the Contractor shall submit an acceptable substitute, and if appropriate, an equitable adjustment shall be made in the Contract amount. Once approved, the list shall not be changed except with written approval of the Owner. Only the listed subcontractors shall perform their designated work items. No substitutes will be permitted without written approval of the Owner.

C. A schedule for completion of the Work indicating the dates of commencement and completion of the various components of the Work, including but not limited to the procurement of equipment, major construction activities, contract closeout and final completion. The Owner shall have the right to make reasonable adjustments in the schedule deemed necessary in the discretion of the Owner.

*****END OF SECTION*****

SECTION F

AGREEMENT

This Agreement dated this ____ day of _____, **2024** is by and between the Board of Education of St. Mary's County (the "Owner") and _____(the "Contractor").

The OWNER and CONTRACTOR agree as follows:

ARTICLE 1
THE WORK

1.1 The Contractor shall fully complete this contract and perform all the Work required by the Contract Documents in accordance with the Contract Documents, for the Stadium Concession Stand Replacement at Leonardtown High School, SMCPS-2024-10-DSS-DC.

ARTICLE 2
TIME OF COMMENCEMENT AND COMPLETION

2.1 The Contractor shall commence work under the Contract within ten (10) calendar days of the date of the Owner's Notice to Proceed. Contractor shall follow through and prosecute the Owner's work diligently until completion. Subject to authorized adjustments, the Contractor shall fully complete the Work within one hundred fifteen (115) calendar days of commencement of Work, at which point in time the project will be in a finished condition, as specified, all temporary buildings, equipment, tools, and surplus and waste materials will have been removed from the job site, and all close-out requirements of the Contract shall have been satisfied. TIME IS OF THE ESSENCE UNDER THIS AGREEMENT.

ARTICLE 3
CONTRACT SUM

3.1 The Owner shall pay the Contractor in current funds for the performance of the Work, subject to additions and deductions by Change Order as provided in the Contract Documents, the Contract Sum of _____ (Written Dollar Amount).

ARTICLE 4
PAYMENTS

4.1 Based upon Applications for Payment submitted by the Contractor, which have been approved by the Owner, and subject to the terms and conditions of the Contract, the Owner shall make progress payments on account of the Contract Sum to the Contractor on a monthly basis, as follows:

Ninety-five percent (95%) of the value of work completed up to the last day of the preceding month, based upon the Contractor's estimate of labor and materials incorporated in the Work, and ninety-five percent (95%) of the value of materials suitably stored at the site of the Work up to the last day of the month, both as approved by the Owner's representative, less the aggregate of previous payments.

ARTICLE 5
FINAL PAYMENT

5.1 Final payment, constituting the entire unpaid balance of the Contract Sum due Contractor (including retainage), shall be paid by the Owner to the Contractor when the work has been finally completed, the Contract fully and properly performed and accepted by the Owner, and a final Certificate of Payment has been issued. The Owner shall make final payment due within thirty (30) days after final completion and acceptance of the Work.

ARTICLE 6
ENUMERATION OF CONTRACT DOCUMENTS

6.1 The Contract Documents, which constitute the entire agreement between the Owner and the Contractor, are enumerated as follows:

1. This Agreement, the General Conditions, and any Special Conditions.

2. The Project Manual (Specifications) for the Project, dated April 8, 2024, consisting of twenty-four (24) pages plus attachments A, B, C, D, E, and F.

3. The following Addenda to the Specifications:

DATE	ADDENDA NUMBER
_____	_____
_____	_____
_____	_____

4. The following Drawings:

Title/Number	*Date*
Cover Sheet/CS1	12/19/2023
Site Plan/C-1	12/19/2023
Code Analysis/A-1	12/19/2023
Proposed Floor Plan/A-2	12/19/2023
Building Elevations and Sections/A-3	12/19/2023
Wall Sections and Details/A-4	12/19/2023
Finish Schedule and Finish Plan/A-5	12/19/2023
Foundation and Roof Framing Plan/S-1	12/19/2023
Typical Details/S-2	12/19/2023
Typical Details/S-3	12/19/2023
Mechanical Legend and Abbreviations/M0.01	12/01/2023
Mechanical Floor and Roof Plans/M1.01	12/01/2023
Miscellaneous Details/M7.01	12/01/2023
Equipment Support Detail/M7.02	12/01/2023
Miscellaneous Control Diagram/M8.01	12/01/2023
Mechanical Equipment Schedules/M9.01	12/01/2023
Plumbing Legend and General Notes/P0.01	12/18/2023
Plumbing Floor Plans/P1.01	12/18/2023
Piping, Support, and Equipment Details/P9.07	12/01/2023
Plumbing Fixture Piping Details/P7.02	12/01/2023
Plumbing Schedules and Equipment Notes/P9.01	12/18/2023
Electrical Legend, Details, and Schedules/E0.01	12/18/2023
Floor Plans-Electrical/E1.01	12/18/2023

5. All modifications and change orders signed by both parties after execution of this Agreement.

The Contract shall not be amended except in by written modification or change order signed by both parties. The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties and supersedes all prior negotiations, representations, or agreements, either written or oral. The Contract Documents shall not be construed to create any third-party beneficiary or other contractual relationship of any kind between the Owner and any third parties.

ARTICLE 7
MISCELLANOUS PROVISIONS

7.1 Provisions concerning liquidated damages for delayed completion, if applicable, are contained in the General Conditions.

IN WITNESS WHEREOF the parties hereto by and through their undersigned authorized representatives set their hands and seals as of the date set forth above.

OWNER - Board of Education of St. Mary's County	**CONTRACTOR** –
_____	_____
Dr. J. Scott Smith Superintendent of Schools	Name:_____ Title:_____
_____	_____
Date Executed	Date Executed
_____	_____
Witness for the Owner	Witness for the Contractor
_____	_____
Notary Public (Seal)	Notary Public (Seal)
My commission expires: _____	My commission expires: _____

*****END OF SECTION****

SECTION G

GENERAL CONDITIONS

GC.1 COMMENCEMENT. PROSECUTION AND COMPLETION OF WORK

The date of commencement of the work is the date established by the Owner in a Notice to Proceed. The date of final completion of the work is the date established by the Owner when construction is fully completed, and all the requirements of the Contract Documents have been satisfied. The Contractor shall begin its work within the required time period following the date of the Notice-to-Proceed and shall carry the work forward expeditiously with adequate forces and shall fully complete the Work within the specified Contract Time allotted for completion of the work. The Contractor shall fully complete the Work within the stated contract time period with the Work being in a finished condition, as specified, with all temporary buildings, equipment, tools, and surplus and waste materials having been removed from the job site and all close-out requirements of the Contract having been satisfied. The Contractor shall supervise and direct the work, using its best skill and attention. The Contractor shall be solely responsible for all construction means, methods, techniques, and procedures and for coordinating all portions of the work under its Contract. A portion of the site will be allotted to the Contractor for the prosecution of its work and the Contractor shall confine its operations to that area.

GC.2 CLAIMS, DELAYS AND EXTENSIONS OF TIME

Definition: A Claim is a demand or assertion by one of the parties seeking as a matter of right, adjustment or interpretation of Contract terms, payment of money, an extension of time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. Claims must be made by written notice. The responsibility to substantiate Claims shall rest with the party making the Claim. Claims must be made in writing addressing the issues surrounding the claim and identifying the nature and extent of the relief requested, including the nature and amount of any adjustment sought in the Contract amount and/or time for performance. Claims by the Contractor must be made within ten (10) days after occurrence of the event giving rise to such Claim or within ten (10) days after the Contractor first recognizes or reasonably should have recognized the condition giving rise to the Claim, whichever is later, otherwise the Claim is waived. Should the Contractor or any of its Subcontractors, Suppliers or Vendors be delayed or disrupted at any time in the progress of the work by any act, omission, neglect or default of the Owner, or by any changes ordered in the work, or by labor disputes, fire, unusual delay in transportation, unavoidable casualties or by any other cause beyond the Contractor's reasonable control, Contractor shall be entitled to an equitable adjustment in its contract time. The Contractor shall not be entitled to, and shall make no claim, for an increase in the Contract amount or other damages for such delay or disruption. Any such delay or disruption shall be fully compensated for by an equitable extension of the contract time to complete the Work. Such extension of time shall be the Contractor's sole remedy for such delay and disruption. Pending final resolution of the Claim(s) and unless otherwise agreed in writing, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments of undisputed amounts in accordance with the Contract Documents.

GC.3 PRE-CONSTRUCTION CONFERENCE

Prior to commencement of work, the Contractor shall meet in conference with representatives of the Owner to discuss and develop mutual understandings pertaining

to administration of the Contract, scheduling, safety, and security requirements.

GC.4 SAFETY REQUIREMENTS

The Contractor shall exercise due care for the safety of all individuals within the project site and shall comply with all applicable federal, state and local workplace safety and hazardous materials, laws, codes, regulations and requirements. The Contractor shall also comply with the "Manual of Accident Prevention in Construction", latest edition, published by the Associated General Contractors of America, Inc., Washington, D.C. The Contractor shall further assure that at least one copy of this manual is available on the job site at all times. Should warnings of unusual winds or adverse weather be issued, the Contractor shall take every practicable precaution to minimize danger to person and damage to the work and to adjacent property.

GC.5 INSURANCE

The Contractor shall purchase and maintain during the life of the Contract:

A. A proper amount of Workmen's Compensation Insurance required under the State Law of Maryland.

B. The proper amount of comprehensive automobile liability insurance required under the Maryland State Law whether Contractor's vehicle is registered in Maryland or not;

C. Property insurance for fire, extended coverage, vandalism and malicious mischief insurance upon the work to one hundred percent (100%) of the insurable value thereof, including items of labor and materials connected therewith, materials in place or to be used as part of the permanent construction, including temporary structures, miscellaneous materials and supplies incident to the work during term of the Contract; and

D. General Liability Insurance in the following amounts:

Bodily Injury	$1,000,000.00 (Each Person) $2,000,000.00 (Each Occurrence)
Property Damage	$2,000,000.00 (Each Occurrence)

All policies shall be written to include protection of the Owner and its agents against claims or losses arising from the operations of the Contractor or its subcontractors. Certified copies of insurance policies or certificates of insurance shall be delivered to the Owner within ten (10) days from the date of Notice of Award; and shall contain a provision that the insurance shall not be canceled except upon not less than ten (10) days notice to the Owner.

E. St. Mary's County Public Schools shall be the certificate holder for all policies.

GC.6 FEDERAL STATE AND LOCAL TAXES

Except as may be otherwise provided in the Contract, the contract price includes all applicable Federal, State and local taxes and duties.

GC.7 INDEMNIFICATION

To the fullest extent permitted by law, the Contractor shall indemnify and hold the Owner

and its agents, employees and representatives harmless from and against any and all claims, accidents, actions, suits, damages, injury, penalties, losses and expenses, attorney's fees, judgments and/or liability arising out of or resulting from the performance of the work and/or the failure to perform in accordance with the Contract Documents, whether by the Contractor or by any of its subcontractors, suppliers, vendors or other party employed by them. This indemnification and hold harmless obligation shall apply regardless of whether or not the claim, damage, injury, loss expense or liability it is caused in part by a party indemnified hereunder. The indemnification obligations under this paragraph shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or any subcontractor under Workman's Compensation acts, disability benefit acts or other employee benefits acts.

GC.8 PLANS AND SPECIFICATIONS

The Contractor shall accomplish all work, including additional, extra and incidental work that may be considered necessary by the Owner to complete the project in a satisfactory and acceptable manner, and shall furnish all plant, equipment, tools, materials, labor and incidentals necessary to carry on the project to satisfactory completion within the time period specified and in strict accordance with the contract requirements, drawings and specifications.

In the event of conflict or variance between the plans and/or specifications, it shall be the duty of the Contractor to call it to the Owner's attention and obtain the Owner's interpretation of the discrepancy. It is also specifically agreed that items mentioned in the plans and not in the specifications or vice-versa, shall be considered as having been included in both, since the plans and specifications are intended to be complementary toward the construction of a complete job. The Contractor's work includes all work, materials, equipment, and operations necessary for and incidental to the complete performance of the work and the project, and unless they are of an unusual nature, specific mention thereof may not be made in the plans or specifications. Should any disagreement arise as to the meaning or intent of anything contained in the plans or specifications, the decision of the Owner shall be final and binding on the Contractor provided such decision is exercised by Owner in good faith. Any errors or omissions in the plans or specifications may be corrected by the Owner when such corrections are necessary for the proper fulfillment of their intent as construed by the Owner.

GC.9 WORKMANSHIP

Workmanship shall be first class in every respect and accomplished by competent (and when applicable properly licensed) workers. The Owner may but is not obligated to visit the site to observe the work as it progresses. Any site visits or observations by the Owner are for its own benefit and shall not give rise to any obligations to the Contractor. Any instance of unsatisfactory work called to the attention of the Contractor shall be corrected promptly. The failure of the Owner to visit the site and/or to report any observed deficiencies to the Contractor shall not constitute an acceptance of non-conforming work and shall not constitute a waiver of any of the Contractor's obligations or the Owner's rights under the Contract Documents All work is to be performed in a first-class manner and in accordance with standard industry practices unless otherwise indicated, and shall be accomplished in a neat and orderly manner.

GC.10 PERMITS

The Owner shall apply for zoning and general building permits for the project, where applicable. The Contractor/subcontractor(s) shall insure that the necessary permits in connection with their various trades are obtained and paid for by the proper time, including all fees for permits, and for certificates of inspection. The Contractor will be responsible for installation of a meter base and all temporary services necessary for

construction.

GC.11 CODES

All work shall be done in strict conformity with applicable Federal, State, County and other prevailing building codes, laws, rules and regulations governing such work. To the fullest extent permitted by law, Contractor shall indemnify and shall hold the Owner and their agents, employees and representatives harmless from all damages, injury, losses, expenses, attorney's fees, penalties, suits, judgments, liability, actions, claims and/or accidents resulting from or relating to any failure to comply with the above-mentioned codes, laws, rules and regulations.

GC.12 CONTRACTOR'S WARRANTY

The Contractor warrants to the Owner that all materials, systems and equipment furnished under this Contract will be new unless otherwise specified. The Contractor further warrants for a period of one year from the date of final acceptance of the Work, that all Work will be of good quality, free from defects or deficiencies, and in conformance with the Contract Documents. With respect to any part of the work which Owner takes possession of prior to final acceptance, such warranty as to that part of the Work shall continue for a period of one year from the date the Owner takes possession. The Contractor further warrants that the Work shall be performed in accordance with accepted industry standards and practices for Projects of similar design and complexity. The Contractor further warrants that in the performance of the Work, it shall exercise that degree of care and skill which a reasonably prudent contractor would exercise under the same or similar circumstances, and that it will use only properly skilled and experienced subcontractors and workmen. All Work, materials, systems and/or equipment not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Contractor shall promptly remedy at its own expense any failure of the Work to conform to these warranties or other Contract requirements, and any damages resulting there from. The Contractor shall likewise warrant any repairs or replacements hereunder for one year from date of such repair or replacement. The Contractor shall also restore any work damaged in fulfilling the terms of these warranties. Should the Contractor fail to remedy any failure, defect, or damage described above, or otherwise satisfy its warranty obligations within a reasonable time after receipt of notice thereof, the Owner shall have the right to replace, repair, or otherwise remedy such failure, defect or damage at the Contractor's expense.

GC.13 VENDOR'S WARRANTIES

In addition to the other rights and remedies provided by this Contract, the Owner shall be entitled to enforce all subcontractors', manufactures', vendors' and suppliers' warranties, expressed or implied, respecting any work, materials, systems and/or equipment. The Contractor shall furnish to Owner all written warranties which the subcontractors, manufacturers, or supplies issue for the work, materials, systems and/or equipment and such warranties shall be issued for the benefit of the Owner.

GC.14 HAZARDOUS MATERIALS WARRANTY

Except for those specifically identified in writing by the Contractor, the Contractor further warrants to the Owner during and upon completion of the Project that to the best of his information, knowledge, and belief no mold, polychlorinated biphenyl (PCB), asbestos containing building materials (ACBM), or other hazardous materials are contained in this

Project. This warranty shall not apply to refrigerants or other materials within self-contained systems or equipment as furnished by the manufacturer.

GC.15 CORRECTIVE WORK

The Contractor shall promptly correct all Work rejected by the Owner as defective or as failing to conform to the Contract Documents whether observed before or after completion and whether or not fabricated, installed or completed. The Contractor shall bear all costs of correcting such rejected Work, including compensation for the Owner's additional services and/or those of its consultants made necessary thereby. The Contractor shall also promptly respond to all issues that are warranty related. The Owner will present all warranty items to the Contractor in writing. The Contractor will be responsible for arranging the applicable subcontractors and completion of all corrections. The corrective work must start within 24-hours of the date of written notice from the Owner, unless other arrangements have been made with the Owner.

GC.16 TECHNICAL PUBLICATIONS

Prior to final completion, the Contractor shall at no additional cost to Owner, furnish the installation, operation, and maintenance manuals for all mechanical, electrical, plumbing, HVAC and other equipment, systems and products furnished under the Contract.

GC.17 CLEAN-UP

The Contractor shall keep all its work areas clean by the daily removal of accumulated waste materials and other debris caused by its operations. Upon completion of its work, the Contractor shall remove all tools, equipment, rigging and surplus materials from the premises and shall leave the job and surrounding area "broom clean" before all work under the Contract shall be considered complete. The finished project shall be clean and ready for use, subject to approval and acceptance by the Owner.

GC.18 SEPARATE CONTRACT

The Owner has the right to let other contracts in connection with the project and the Contractor shall fully and completely cooperate with all other Contractors.

GC.19 MODIFICATION OF CONTRACT

When changes in the work require modification of the Contract, such modification shall be accomplished as follows:

A. A Change Order is a written order to the Contractor signed by the Owner (Architect/Engineer, if applicable) and Contractor, issued after execution of the Contract, authorizing a change in the work or an adjustment in the Contract Sum or the Contract Time. The Contract Sum and the Contract Time may be changed only by Change Order. A Change Order signed by the Contractor indicates its agreement therewith, including the adjustment in the Contract Sum or the Contract Time stated therein.

B. Should it be desired at any time, during the progress of the work to make any alterations or changes, or to add to or delete Work, the Owner shall have the undisputed right, without invalidating the Contract, to make such changes, omissions, additions or alterations by change order or constructive directive. The Architect/Engineer (if applicable) shall also have the right to order minor changes in

the Work which do not affect the Contract time or amount.

C. A written request for a change in the Work may be made to the Owner (the Architect/Engineer, if applicable) or the Contractor, but the Owner must authorize and approve all changes.

D. The Contractor shall promptly submit to the Owner a fully itemized breakdown of the items of work and quantities and prices used in computing the value of the requested change along with a detailed explanation and justification for the proposed change regardless of the nature of the change.

E. For all changes in the Work to be performed by a subcontractor, the Contractor shall furnish the subcontractor's fully itemized breakdown of the items of work and quantities and prices which shall bear the original signature of a representative of the subcontractor authorized to act for the subcontractor. If requested by the Owner, proposals from suppliers or other supporting data required to substantiate costs shall be furnished.

F. Modifications of the Contract Price, when required, shall be determined as follows:

1. By unit price when unit prices are stated in the Contract or have been subsequently agreed upon.
2. By a lump sum price agreed upon by both the Owner and Contractor.

G. No work on proposed changes will be started until the estimate of the cost and additional time for the proposed change has been approved in writing by the Owner.

1. Unless otherwise specified, the allowable Contractor mark-up for combined overhead and profit will be based upon the direct cost of the work or materials in accordance with the following schedule:

Cost of Work	Combined Overhead and Profit
$0 - $1,000	20%
$1,001 - $5,000	15%
$5,001 - $10,000	10%
$10,001 - $25,000	6%
Over $25,000	Negotiated but not more than 5%

GC.20 TITLE TO THE WORK

The Contractor warrants and guarantees that title to all work, materials, systems and equipment covered by an application for payment, whether incorporated in the project or not, will pass to the Owner upon the receipt of such payment by the Contractor, free and clear of all liens, claims, security interests or encumbrances and that no work, materials or equipment covered by an application for payment has been acquired by the Contractor or by any other individual or entity performing the work or furnishing materials and equipment for the project, subject to an Agreement under which an interest therein or an encumbrance thereon is retained by the seller or otherwise imposed upon the Contractor or such other person. Notwithstanding the transfer of title, Contractor shall remain liable for loss of or damage to the work, materials, systems and equipment until final acceptance of all Work by the Owner under the contract.

GC.21 PAYMENT

After the Contractor has issued an application for payment, the Owner shall make payment of amounts due in the manner provided in the Contract, except that there will be a 5% retainage on all payments. However, neither certificate for a progress payment, nor any progress payment shall constitute an acceptance of any work which is not in compliance with the Contract Documents. The Owner may decline to approve an application for payment and may withhold their certificate in whole or in part, to the extent necessary and reasonable to protect the Owner. Payment of amounts due will be made within thirty (30) days after Owner's receipt of Contractor's Application for Payment, provided the work for which payment is requested is in compliance with the Contract Documents, and the Contractor is otherwise in compliance with the Contract.

GC.22 FINAL COMPLETION AND FINAL PAYMENT

Upon receipt of written notice that the work is ready for final inspection and acceptance, and upon receipt of a final application for payment, the Owner will make such inspection; and upon finding the work if finally, complete and acceptable under the Contract documents and the Contract fully performed, the Owner will issue a Final Completion and Payment Certificate. Final Completion shall be when all the Work is fully completed and in a final and finished condition in accordance with the Contract Documents, with all temporary buildings, equipment, tools, and surplus and waste materials having been removed from the job site and all close-out requirements of the Contract having been satisfied. The acceptance of final payment shall constitute a waiver of all claims by the Contractor except those previously made in writing and identified as unsettled at the time of the final application for payment.

The close out requirements of the Contract includes the following:

(1) An affidavit from Contractor that all payrolls, bills for materials, systems and equipment, and other indebtedness connected with the Work for which the Owner or his property might in any way be responsible, have been paid or otherwise satisfied.

(2) Consent of the Contractor's surety, if any, to final payment

(3) A complete and current set of record drawings showing all Contractor's field changes and selections affecting the general construction of the Project and Contractor's Work, which drawings shall indicate and illustrate the Work as actually installed.

(4) Instruction of Owners' representatives in the operation of mechanical, electrical, plumbing and other systems included in the Work.

(5) Delivery of keys to Owner with keying schedule; master, sub-master and special keys,

(6) Delivery to Owner of manufacture's product, system and equipment warranties and any necessary assignments thereof together with any specified certificates of inspections,

(7) Delivery to Owner of all operating, servicing, maintenance and cleaning instructions and/or manuals,

(8) Any other close out requirements otherwise specified in the Contract Documents

GC.23 CONTRACTOR'S APPLICATION FOR PAYMENT

The Contractor shall submit an original, and one (1) copy of its Application for Payment to the St. Mary's County Public Schools, Department of Design and Construction, 27190 Point Lookout Road, Loveville, Maryland 20656, utilizing the AIA form G702 Application and Certification for Payment.

Payment applications shall contain the following information:

A. Name of Contractor,

B. Project Name,

C. Description of Work,

D. Item Numbers, and

E. Invoice Date

GC.24 (NOT APPLICABLE)

GC.25 SUBCONTRACT RELATIONS

By an appropriate agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Documents, assumes toward the Owner.

GC.26 ENVIRONMENTAL HAZARDS

In the event the Contractor encounters asbestos, petroleum products, or any other "hazardous substance" on the project, Contractor shall immediately stop work, notify the Owner in writing, and shall not resume work in the affected area until the affected area has been remediated and rendered harmless.

GC.27 HAZARDOUS MATERIALS

At the request of the Owner, and/or to the extent required by law, the General Contractor and each Subcontractor shall provide material safety data sheets (MSDS), for all hazardous materials contained in any building material, system, building component or parts thereof.

GC.28 TERMINATION

The Owner shall have the right upon 24 hours notice to terminate the Contract with or without cause for any reason, including the Owner's convenience. In the event of such termination, Contractor shall be entitled to the value of all Work in place, including an amount representing a reasonable profit and overhead for such work, but shall not be entitled to any compensation for work not performed as of the date of the termination.

GC.29 APPLICABLE LAW

All applicable federal, state and local laws and regulations shall apply to the Contract including but not limited to the applicable sections of the Education Article and the State Finance and Procurement Article of the Annotated Code of Maryland. The Contractor and all of its Subcontractors, Suppliers, Vendors and delivery personnel shall

comply with all applicable Board of Education policies and regulations when on Board of Education property with regard to their interactions with Board of Education personnel and/or students. This Contract shall not be assigned without the written consent of the Owner and Contractor. The Contract shall be governed by laws of the State of Maryland and construed without regard to any presumption against the party(s) who drafted the agreement. The parties agree that the State Courts of St. Mary's County, Maryland shall be the sole venue for resolution of all disputes arising under this Agreement, and/or arising out of the Project which is the subject of this Agreement.

GC.30 MARYLAND SEX OFFENDER LAW

Potential contractors/vendors of the Board of Education of St. Mary's County are advised that Maryland law now provides the following mandatory restrictions on registered sex offenders performing work or services on school system property:

"A person who enters into a contract with a county board of education or a nonpublic school may not knowingly employ an individual to work at a school if the individual is a registrant. A person who violates this section is guilty of a misdemeanor and upon conviction is subject to imprisonment not exceeding 5 years or a fine not exceeding $5,000 or both."

Persons or entities awarded contracts with the Board of Education of St. Mary's County are required to certify that no employee, subcontractor, subcontractor employee, or material supplier that is a registered sex offender will be allowed to enter onto school system property at any time in the performance of the work or services for which the contract is awarded. Such certification is a condition precedent to any contract award, and failure to so certify will be grounds for not awarding a contract. It will be the responsibility of contractors to obtain similar certification from all subcontractors and material suppliers performing work or services on school system property and to monitor adherence to this requirement. In the event that the Board of Education of St. Mary's County determines that a registered sex offender has entered upon school system property in the performance of work for a contractor/vendor, such will be grounds for termination of the contract. This provision shall be incorporated verbatim into all contracts and subcontracts for work and services performed for the Board of Education of St. Mary's County.

GC.31 SPECIAL REQUIREMENTS

A. NO SMOKING POLICY: Smoking or the possession of any tobacco product, including vapes, within the limits of the school property is a violation of Maryland law. This includes the office trailers, vehicles, staging area, and any facility or location within the property lines of St. Mary's County Public Schools. First offense violations of this offense will be brought to the Contractor's attention to be dealt with. It is the General Contractor's responsibility to inform all personnel of this requirement. It is also the Contractor's responsibility to "police" these actions and control the use of tobacco products. If violations persist, local law enforcement officials will be contacted to enforce the law.

B. NO DRUG POLICY: Possession of illegal drugs and/or drug paraphernalia is strictly prohibited. Since the work involved in this project is in a school zone, strict penalties may result from infractions against these types of laws.

C. Contractor shall provide temporary construction, equipment, and utilities to maintain power, lighting, heating, cooling and ventilation, electric, data, telephone,

intercom, and water service including hot and cold water and sanitary / storm drainage during all occupied times during construction. Any interruption in these services must be restored by the Contractor within 12 hours. If services are not restored within this timeframe, the Owner may have necessary repairs completed and deduct all costs associated with the repair(s) from the contract sum.

D. CONCEALED WORK: Before backfilling, placing concrete, or performing other Work which will conceal mechanical and electrical lines and items, concrete reinforcing, anchors and other items to be concealed in finished Project, secure inspection and approval by Owner's Representative and other local inspectors having jurisdiction. Record exact locations of mechanical, electrical and site utility work on the "Record Drawings".

E. Contractor shall retain the services of an underground utility locating service as required to investigate all areas of proposed excavation. Prior to any excavation the Contractor shall review the contract drawings, consult with the Owner, and retain the services of Miss Utility and an independent utility locating service as required to establish the possible location(s) of all underground utilities. The Contractor will request from the Owner's Representative, in writing, to locate all private underground utilities in and around the work area.

F. TEMPORARY SANITARY FACILITIES: Provide adequate sanitary conveniences of a type approved for the use of persons employed on the work, properly secluded from public observation, and maintained in such a manner as required or approved by the County Health Department. Maintain these conveniences at all times without nuisance. Upon completion of the work, remove the conveniences from the premises, leaving the premises clean and free from nuisance.

   Dispose of sewage through use chemical toilets or comparably effective units, and periodically empty wastes into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Include provisions for pest control and elimination of odors.

   The Contractor is fully responsible to the State, County and local Health Departments, their inspections and their requirements for sanitary facilities. Requirements imposed by agencies having jurisdiction shall be immediately addressed by the Contractor at no additional cost to the Owner.

G. CONTRACTOR PARKING: All Contractor and Contractor employees shall park privately, and Company owned vehicles in the designated staging area or area approved by the Owner. Contractor employee parking shall not interfere with existing and established parking requirements.

GC.32 OPERATION AND MAINTENANCE DATA

PRODUCT MAINTENANCE MANUALS

A. 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.

B. 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.

C. 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.

D. 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.

E. 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.

F. SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. 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 warranty and bond information, as described below.

B. 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.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.

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.

D. 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.

E. 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.

F. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.

G. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

H. 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.

I. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

J. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

K. Include procedures to follow and required notifications for warranty claims.

GC.33 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings.

B. 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.

C. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.

D. Mark record sets with red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

E. Mark important additional information that was either shown schematically or omitted from original Drawings.

F. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

*****END OF SECTION****

SECTION H

SPECIAL CONDITIONS

SC.1 The following Special Conditions shall apply to the Contract: NONE

ATTACHMENTS

Attachment A	Bid Bond Form (004313)
Attachment B	Non-Collusion Affidavit (004519)
Attachment C	Sex Offender Certification (004521)
Attachment D	Performance Bond (006113.13)
Attachment E	Labor and Material Bond (006115)
Attachment F	Sample Letter of Surety

*****END OF SECTION*****

BOARD OF EDUCATION
ST. MARY'S COUNTY BOARD OF EDUCATION

BID BOND

KNOW ALL MEN BY THESE PRESENTS: that we _____

as Principal, hereinafter called the Principal and, _____
a corporation duly organized under the laws of the State of _____as Surety, hereinafter called the Surety, are held and firmly bound unto

St. Mary's County Public Schools
23160 Moakley Street
Leonardtown, Maryland 20650

as Obligee, hereinafter called Obligee, in the sum of _____

_____ Dollars ($ _____)
for payment of which sum well and truly to be made, the said Principal and said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for the **Stadium Concession Stand Replacement at Leonardtown High School, Leonardtown, Maryland.**

NOW, THEREFORE, if the Obligee shall accept the bid of the Principal and the Principal shall enter into a Contract with the Obligee in accordance with the terms of such bid, and give such bond or bonds as may be specified in the bidding or Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter such Contract or give such bond or bonds, if the Principal shall pay to the Obligee the difference not to exceed the penalty thereof between the amount specified in said bid and such larger amount for which the Obligee may in good faith contract with another party to perform the Work covered by said bid, then this obligation shall be null and void, or otherwise to remain in full force and effect.

This bond shall be governed in all respects, whether as to validity, construction, capacity, performance or otherwise, by the laws of the State of Maryland, without regard to the principals or conflict of laws and without regard to any presumption or otherwise requiring construction against the party who drafted it. The parties hereto irrevocably consent and submit to the jurisdiction of the state courts in and for St. Mary's County, Maryland, and further agree that such courts shall constitute the exclusive venue for any suit, action, or judicial proceeding arising out of or relating to this bond or its enforcement.

Signed and sealed this _____ day of _____ 20_____.

_____ _____
(Witness) (Principal) (Seal)

_____ _____
(Witness) (Title)

_____
(Surety) (Seal)

_____
(Title)

MARYLAND STATE PROCUREMENT ARTICLE 21, SECTION 3-405:
VENDOR/CONTRACTOR DISQUALIFICATION - BRIBERY.

A person convicted for bribery, attempted bribery, or conspiracy to bribe shall be disqualified from entering into a Contract with any county or other subdivision of the State. Every business entity upon submitting a bid or otherwise applying for a Contract shall submit an affidavit stating whether it, its officers, directors, or partners, or its employees have been convicted of bribery, attempted bribery, or conspiracy to bribe under the laws of any State or Federal government.

_____ affirms that it is in full compliance with the aforementioned
(COMPANY NAME)
Maryland State Procurement Article 21, Section 3-405.

STATEMENT OF NON-COLLUSION

The undersigned affirms that this bid is made without any previous understanding, agreement or connection with any person, firm or corporation submitting a bid for the same items and/or services and is, in all respects, fair and without collusion or fraud; and that no member of the Board of Education of St. Mary's County, St. Mary's County Public Schools, the Administrative or Supervisory personnel, or other employees of the St. Mary's County Public Schools will benefit from the award of this bid in violation of Maryland law.

Name of Authorized Company Representative: _____
(PRINT OR TYPE NAME)

Signature of Authorized Company Representative: _____

To be completed by an authorized company representative and a Notary Public:

Dated at _____ this _____ day of

_____ 20 _____.

Name of Organization _____

By _____ being duly sworn
(NAME)
deposed and says that he/she is the _____ of
(OFFICER)
_____, and that all the foregoing statements are true and correct.
(CONTRACTING FIRM NAME)

Subscribed and sworn before me this _____ day of _____, 20_____.

Notary Public: _____

My Commission Expires: _____

SEX OFFENDER CERTIFICATION

In conjunction with the submission of its bid, and as a condition precedent to the award of a Contract by the St. Mary's County Board of Education, the undersigned bidder, by and through its authorized undersigned representative, acknowledges the following provisions of the Criminal Procedure Article of the Annotated Code of Maryland relating to the employment of registered sex offenders, and certifies as follows:

Annotated Code Criminal Procedure Article Provisions

§ 11-722. Entry onto school or day care property prohibited.
(c) Employment of registrants at schools prohibited. -- A person who enters into a contract with a county board of education or a nonpublic school may not knowingly employ an individual to work at a school if the individual is a registrant. (d) Violations; penalty. -- A person who violates this section is guilty of a misdemeanor and on conviction is subject to imprisonment not exceeding 5 years or a fine not exceeding $ 5,000 or both.

Certification

The undersigned bidder hereby certifies to the Board of Education of St. Mary's County that no employee, subcontractor, subcontractor employee, or material supplier that is a registered sex offender will be allowed to enter onto school system property at any time in the performance of the work or services for which the contract is awarded.

Name of Individual/Organization (Bidder):_____
(Print or type name)

Name of Authorized Representative: _____
(Print or type name)

Signature of Authorized Representative: _____

The aforesaid bidder further acknowledges that it will be the responsibility of all contractors to obtain similar certifications from all subcontractors, suppliers and vendors delivering materials, equipment or supplies to school system property, and/or performing work or services on school system property, and to monitor adherence to this requirement. In the event that the Owner determines that a registered sex offender has entered upon school property for a delivery of materials, equipment or supplies and/or for the performance of work or services under the contract, such will be grounds for termination of the contract.

St. Mary's County
Board of Education

BOND NUMBER _____

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: that _____

as Principal, hereinafter called Contractor and, _____

as Surety, herein after called Surety, are held and firmly bound unto

Board of Education of St. Mary's County
23160 Moakley Street
Leonardtown, Maryland 20656

as Obligee, hereinafter called Owner, in the amount of_____

_____Dollars (_____), for the payment whereof Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS,

Contractor has by written agreement entered into a Contract with Owner for the **Stadium Concession Stand Replacement at Leonardtown High School, Leonardtown, Maryland** in accordance with Drawings and Specifications prepared by **Restoration Engineering, Inc.**, which Contract is **by reference made part thereof, and is hereinafter referred to as the Contract.**

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if Contractor shall promptly and faithfully perform said Contract, then this obligation is null and void; otherwise it shall remain in full force and effect

The Surety hereby waives notice of any Contract alteration or extension of time made by the Owner.

Whenever Contractor shall be, and declared by Owner to be in default under the Contract, the Owner having performed Owner's obligation thereunder, the Surety may promptly remedy the default, or shall promptly:

1. Arrange for the Contractor, with the consent of the Owner, to complete the Contract in accordance with its terms and conditions, or

2. Undertake to perform and complete the construction Contract itself, through its agents or through independent qualified Contractors acceptable to the Owner, or

3. Obtain a bid or bids from qualified Contractors acceptable to the Owner for completing the Contract in accordance with its terms and conditions, and upon determination by Surety of the lowest responsible bidder, or if Owner elects, upon determination by the Owner and Surety jointly of the lowest responsible bidder, arrange for a Contract between such bidder and Owner to be secured with Payment and Performance bonds from a qualified surety and make available as Work progresses (even though there should be a default or a succession of defaults under the Contract or Contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the Contract price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the penal amount set forth in the first paragraph hereof. The term "balance of the Contract price," as used in this paragraph, shall mean the total amount payable by the Owner to the Contractor under the Contract and any amendments thereto, less the amount paid by Owner to Contractor.

4. No right of action shall accrue on this bond to or for the use of any person or corporation other than the Owner named herein or the heirs, executors, administrators or successors of the Owner.

5. This bond shall be governed in all respects, whether as to validity, construction, capacity, performance or otherwise, by the laws of the State of Maryland, without regard to the principals or conflict of laws and without regard to any presumption or other rule requiring construction against the party who drafted it. The parties hereto irrevocably consent and submit to the jurisdiction of the state courts in and for St. Mary's County, Maryland, and further agree that such courts shall constitute the exclusive venue for any suit, action, or judicial proceeding arising out of or relating to this bond or its enforcement.

Signed and sealed this _____ day of _____ 20 _____.

_____ (Witness)	_____ (Principal) (Seal)
_____ (Witness)	_____ (Title)
	_____ (Surety) (Seal)
	_____ (Title)

St. Mary's County

Board of Education

LABOR AND MATERIAL PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: that _____
(INSERT FULL NAME AND
_____
ADDRESS OR LEGAL TITLE OF CONTRACTOR)

as Principal, hereinafter called Principal and, _____
(INSERT FULL NAME AND
_____
ADDRESS OR LEGAL TITLE OF SURETY)

as Surety, hereinafter called Surety, are held and firmly bound unto

Board of Education of St. Mary's County
23160 Moakley Street
Leonardtown, Maryland 20656

as Obligee, hereinafter called Owner, in the amount of _____

_____ DOLLARS ($_____), for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these present.

WHEREAS,

Principal has by written agreement entered into a Contract with Owner for the Stadium **Concession Stand Replacement At Leonardtown High School, Leonardtown, Maryland** in accordance with Drawings and Specifications prepared by **Smolen, Emr, Ilkovitch Architects, Inc.**, which Contract is **by reference made part hereof, and is hereinafter referred to as the Contract.**

LABOR AND MATERIAL PAYMENT BOND

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if Principal shall promptly make payment to all claimants as hereinafter defined, for all labor and material used or reasonably required for use in the performance of the Contract, then this obligation shall be null and void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

1. A claimant is an individual or entity having a direct contractual relationship with Contractor, subcontractor or sub-subcontractor, who supplied labor, material or both, used or reasonably required for use in the performance of the Contract. Claimant includes a lessor of equipment to the extent of the fair rental value of equipment directly applicable to the Contract.

2. The above named Principal and Surety hereby jointly and severally agree with the Owner that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such claimant's work or labor was performed, or materials were furnished by such claimant, may sue on this bond for the use of such claimant, prosecute the suit to final judgment for such sum or sums as may be justly due the claimant, and have execution thereon. The Owner shall not be liable for the payment of any costs or expenses or any such suit.

3. No suit or action shall be commenced hereunder by any claimant:

    a) Unless claimant, other than one having a direct contract with the Principal, shall have given written notice to the Principal within ninety (90) days after such claimant did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name or the party to whom the materials were furnished, or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by certified mail, postage prepaid, in an envelope addressed to the Principal, at Principal's residence or office which is regularly maintained for the transaction of business.

    b) After the expiration of one (1) year following the date on which the Owner finally accepts the Work on the Contract (Substantial Completion), it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof such limitation shall be deemed amended so as to be equal to the minimum period of limitation permitted by such law.

4. The amount of this bond shall be reduced by and to the extent of any payment of payments made in good faith hereunder, inclusive of the payment by Surety of mechanics' liens which may be filed of record against said improvement whether or not claim for the amount of such lien be presented under or against this bond.

5. This bond shall be governed in all respects, whether as to validity, construction, capacity, performance or otherwise, by the laws of the State of Maryland, without regard to the principals or conflict of laws and without regard to any presumption or other rules requiring construction against the party who drafted it. The parties hereto irrevocably consent and submit to the jurisdiction of the state courts in and for St. Mary's County, Maryland, and further agree that such courts shall constitute the exclusive venue for any suit, action, or judicial proceeding arising out of or relating to this bond or its enforcement.

Signed and sealed this _____ day of _____, 20 _____.

_____ (Witness)	_____ (Principal) (Seal)
_____ (Witness)	_____ (Title)
	_____ (Surety)
	_____ (Title)

Attachment F

SAMPLE LETTER OF SURETY

TRAVELERS

June 27, 20__

St. Mary's County Public Schools
Department of Design and Construction
27190 Point Lookout Road
Loveville, Maryland 20656

RE: Bidder:
Project: RFP #
Bid Date:

To Whom It May Concern:

As surety for , Travelers Casualty and Surety Company of America is prepared to issue the Performance and Payment Bond should be awarded a contract in excess of $50,000.00 for the referenced project.

Our willingness to issue the performance and payment bonds is subject our approval of the final contract documents and bond forms and our standard underwriting requirements at the time of the request.

TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA

By: _____

City/County of _____
State of Maryland
Sworn to and subscribed before me this __th
day of _____, 20__.
Witness my hand and official seal.
_____ Notary Public

My Commission Expires _____

SECTION 011000 - SUMMARY OF WORK

PART 1 GENERAL

1.1. PROJECT INFORMATION

A. Location:

1. Leonardtown High School
23995 Point Lookout Rd
Leonardtown, MD 20650

B. Owner:

1. The Board of Education of St. Mary's County
23160 Moakley Street
Leonardtown, MD 20650

C. Architect:

1. Smolen Emr Ilkovitch Architects
9211 Corporate Blvd., Suite 340
Rockville, MD. 20850

D. Architect's Consultants:

1. Civil Engineer
Collinson Oliff & Associates
110 Main Street
Prince Frederick, MD 20678
2. Structural Engineer:
Comprehensive Structural Solutions
9220 Wightman Rd, Suite 120
Montgomery Village, MD 20886
3. MEP Engineer:
Alban Engineering
303 International Circle, Suite 450
Hunt Valley, MD 21030

1.2. DESCRIPTION

A. Work included

1. Unless otherwise noted, Contractor shall provide and pay for all labor, materials, equipment, tools, construction machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work required by the Contract Documents.
2. Work of Contract can be summarized by reference to the Contract, General Conditions, Supplementary Conditions, specification sections as listed in the "Table of Contents" bound herewith, drawings issued concurrently with this Project Manual, addenda and modifications to the Contract Documents issued subsequent to the initial printing of the project specifications, and including but not necessarily limited to printed matter referenced by any of these. It is recognized that work of Contract is also unavoidably affected or influenced by governing regulations, natural phenomenon including weather conditions, and other forces outside the Contract Documents.

3. In the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following priorities:

a. The Contract.

b. Addenda, with those of later date having preference over those of earlier date.

c. The Supplementary Conditions.

d. The General Conditions of the Contract for Construction.

e. Drawings and Specifications. In the case of an inconsistency between Drawings and Specifications or within either Document not clarified by addendum, the better quality or greater quality of Work shall be provided in accordance with the Architect's interpretation.

4. Drawings are not to be scaled. All indicated dimensions are to be field-verified as required.

B. The project consists of the construction of a new 2,100 SF one-story outbuilding with masonry bearing walls and a wood truss roof. The Area of Work includes the new structure and associated sitework. The building will include a Concessions room, storage, restrooms and, under Alternate #1, a Team Room. Under Alternate #2, an extended overhang above the serving windows will be added. Refer to civil drawings for complete scope of sitework.

C. Regulatory requirements: All work shall be completed in accordance with all applicable Federal, State and Local codes, ordinances, laws and other regulations which have jurisdiction over the nature of the construction. If any of the above are at variance with the design in the contract documents, notify the Architect immediately prior to construction or installation.

1.3. WORK BY OWNER:

A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

1.4. WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of Authority Having Jurisdiction.

B. On-Site Work Hours: Limit work to normal business hours of 7:00a.m. to 5:30p.m. Monday through Friday, unless otherwise indicated.

1. Weekend Hours: As approved by Owner.

2. Early Morning Hours: As approved by Owner.

C. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to neighboring residences with Owner.

1. Notify Owner not less than two day in advance of proposed operations and obtain written permission before proceeding with disruptive operations.

D. Restricted substances: Use of tobacco products including e-cigarettes or other controlled substances on site is not permitted.

1.5. HOUSEKEEPING

A. Fire protection during construction

B. Provide and maintain hand fire extinguishers suitable for fire hazard involved at convenient accessible locations during construction.

1. Provide each storage location with at least one approved portable fire extinguisher having a rating of not less than 20 - B:C.

2. Place portable extinguishers rated not less than 2A so that maximum travel distance to the nearest exit shall not exceed 100 feet.

C. Avoid accumulation of flammable debris and waste within the building and vicinity. Avoid large and unnecessary accumulations of combustible forms and form lumber. Keep lumber stacked in an orderly manner.

D. Store flammable or volatile liquids in the open or in small detached structures or trailers. Handle liquids with low flash points to be used within the building in approved safety cans. Supervise closely the storage of paint materials and other combustible finishing and cleaning products. Do not permit oily rags to be stored in closets or other tight permanent spaces.

E. Prohibit smoking on school property.

F. Closely supervise welding and torch cutting operations near combustible materials.

G. Supervise locations and operation of temporary portable heating units and fuel.

H. Use only fire-resistant building paper, plastic sheet, and tarpaulins for temporary protection.

I. Do not store combustible material outdoors within 10 feet of a building or structure.

J. Do not use gasoline for cleaning within the building under any circumstances.

K. Take other precautions suitable for hazardous conditions at the site to prevent fire.

L. Burning

1. Do not burn any trash or other material on site.

M. Clean Up

1. The contractor is responsible for cleanup of the adjacent rooms and areas used for next day’s normal school activities that occur inside and outside the construction containment spaces. All cleaning is to be provided by a professional cleaning services contractor and OWNER only acceptable standard is “White Glove Clean”.

1.6. SALVAGE RIGHTS

A. Not applicable.

1.7. DEVIATIONS FROM THE CONTRACT

A. The contractor will notify the Owner of any deviations from the Contract documents prior to any change being made. Any deviation from the Contract without the written authorization of the Owner shall be sole responsibility of the Contractor. In such instances, at the Owner’s sole discretion, the Contractor may be required to modify completed portions of the work to bring them into compliance with the project documents and design intent.

1.8. 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 the Contractor unless specifically stated otherwise.

B. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. Drawing requirements are to be performed by the Contractor unless specifically stated otherwise. 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 as indicated on the drawing legends.

1.9. HARDHATS

A. For safety purposes, HARDHATS are absolutely mandatory for ALL personnel at ALL times on the site NO EXCEPTIONS.

B. The Contractor is responsible for providing these hardhats to ALL of their workers on the site including subcontractors, temporary laborers, etc, as required.

C. A two-inch tall number of a color that contrasts with the hardhat shall provided on the front and back of each hardhat.

D. Any worker found not wearing their assigned hardhats may be removed permanently from the project, without recourse of any kind.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

SECTION 01 23 00 – ALTERNATES

PART 1 - GENERAL

1.1. DESCRIPTION

A. Definition: An Alternate is an amount proposed by Bidders and Stated on the Bid Form for certain construction activities defined in the Bidding Requirements that may be added to or deducted from Base Bid amount of construction to be completed, or in the products, materials, equipment, systems or installation methods described in Contract Documents.

B. Coordination: Coordinate Related Work and modify or adjust adjacent Work as necessary to ensure that Work affected by each accepted Alternate is complete and fully integrated into the project at no additional cost to that proposed on the Bid Form.

C. Notification: Immediately following the award of the Contract, prepare and distribute to each party involved notification of the status of each Alternate. Indicate whether Alternates have been accepted, rejected or deferred for consideration at a later date.

D. Bidder-originated Alternates or qualifying statements will not be considered.

1.2. SCHEDULE OF ALTERNATES

The project drawings and specifications contain requirements for materials and methods necessary to achieve the Work described under each Alternate. Include as part of each Alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.

The following is a list of ALTERNATES. Include the amount for each alternate in the FORM OF PROPOSAL. The Owner reserves the right to accept any, all or none of the alternates listed herein, in any order, at the Owner's sole discretion for a period of sixty (60) days from Notice to Proceed, for the price stated in the FORM OF PROPOSAL. Include or delete all costs of associated work in Alternate Bid Proposal, including, but not limited to, structural, plumbing, electrical, demolition work, etc.:

1. **ALTERNATE NO. 1** – Team Room

Provide Team Room C107 and all associated items (including but not limited to: clerestory windows, door, markerboard, benches, finishes, mechanical equipment, lights, etc) as shown in the drawings.

Base Bid: The south wall of C107 is to instead be a typical exterior cavity wall with a roof overhang as indicated on Proposed Floor Plan 1/A-2.

2. **ALTERNATE NO. 2** – Extended Overhang

Provide extended overhang and supporting masonry piers south of Concessions C100, as indicated in the drawings. Refer to mechanical drawings for modified ductwork under this alternate (including louver in overhang ceiling), and to electrical drawings for modified lighting fixtures. Provide painted school logo per elevations.

Base Bid: Provide a 2'-0" roof overhang beyond the south face of the building, as indicated on Proposed Floor Plan 1/A-2.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

SECTION 012500 – 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.

B. Related Requirements:
1. Division 01 Section “ Alternates” for products used under an alternate.
2. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1. 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.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
    a. Substitutions for Convenience will only be entertained during the bidding period.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify 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 CSI From 13.1A.
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. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. 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.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. 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.
m. 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. Owner's Action: If necessary, Owner will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Owner will notify Contractor of acceptance or rejection of proposed substitution within 30 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Supplemental Instructions for minor changes in the Work.
b. Use product specified if Owner 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 30 days prior to time required for preparation and review of related submittals.

1. Conditions: Owner will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Owner 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: Not allowed except under the following conditions:

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

a. **All Substitutions for Convenience must be submitted and approved prior to bid award. Substitutions for Convenience will not be entertained during the Construction Administration period.**

b. 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.
c. Requested substitution does not require extensive revisions to the Contract Documents.
d. Requested substitution is consistent with the Contract Documents and will produce indicated results.
e. Substitution request is fully documented and properly submitted.
f. Requested substitution will not adversely affect Contractor's construction schedule.
g. Requested substitution has received necessary approvals of authorities having jurisdiction.
h. Requested substitution is compatible with other portions of the Work.
i. Requested substitution has been coordinated with other portions of the Work.
j. Requested substitution provides specified warranty.
k. 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

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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1.3 MINOR CHANGES IN THE WORK

A. The Owner will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, as Supplemental Instructions.

B. The Contractor shall not initiate any Changes in the Work, unless first approved by the Owner and Owner's Representative.

1.4 REQUESTS FOR PROPOSAL (RFP's)

A. Owner-Initiated RFP's: The Owner's Representative will issue an RFP that includes 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. Issues originating RFP's include, but are not limited to:

1. Owner Generated Requests
2. Field and Unforeseen Conditions
3. Errors and/or Omissions by Design Team
4. Contractor Claims
5. Reconciliation of Contract Allowances
6. Acceptance of Contract Alternates
7. Code, Inspector, or Permit Requirements
8. Supplementary Instructions, Directive Letters, and Construction Bulletins

B. Contractor-Initiated Proposals: If latent or unforeseen conditions or direction by the Owner require modifications to the Contract, Contractor may propose changes by submitting a request for a change to the Owner's Representative.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a summary and complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a detailed breakdown of costs directly attributable to the change, including labor and supervision. Provide breakdown of size of crew, type of laborer, number of hours for each crew member to complete their portion of the Work and associated labor rates for each crew member. Provide this information for both additional costs and credits due

back to owner. All costs should based on published trade prices and productivity rates for type of crew and size. General Contractor to compile all subcontractor costs associated with the change and in their cover letter provide an itemized breakdown and comparison to installed costs per RS Means 2019 or later version. Unit costs shall be used where applicable as listed – Refer also to Unit Costs, Section 12200.

3. Include a detailed list of products and materials required or eliminated with associated unit costs and a total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
4. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
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.

C. The Owner's Representative will assign the RFP a number and issue copies to the Owner, the Contractor, and other parties as deemed appropriate.

D. It is the Contractor's responsibility to notify the Owner's Representative whenever an event or issue may require adjustment to the Contract Sum or the Contract Time.

E. The Contractor shall maintain up-to-date RFP / Proposal Logs that track all Requests for Proposals, pending proposals, and change orders.

F. The issuance of a RFP is used only as a means of tracking a potential adjustment to the Contract Sum or the Contract Time. A RFP does not signify the acceptance or acknowledgment by the Owner of any claim and does not authorize any work to be performed unless expressly stated.

G. PRICING DIRECTION

1. Each RFP shall provide pricing direction to the Contractor

a. The Contractor shall provide a proposal prior to proceeding with the Work. No Work specified in the RFP is authorized until written direction is issued by the Owner's Representative. The contractor shall include a detailed breakdown of the anticipated costs and credits including:
   1) A detailed breakdown of costs directly attributable to the change, including labor and supervision. Provide breakdown of size of crew, type of laborer, number of hours for each crew member to complete their portion of the Work and associated labor rates for each crew member. Provide this information for both additional costs and credits due back to owner. All costs should based on published trade prices and productivity rates for type of crew and size. General Contractor to compile all subcontractor costs associated with the change and in their cover letter provide an itemized breakdown and comparison to installed costs per RS Means 2019 or later version. Unit costs shall be used where applicable as listed – Refer also to Unit Costs, Section 12200.
   2) A detailed list of products and materials required or eliminated with associated unit costs and a 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) 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.

1.5 PROPOSALS

A. Within the time specified in the RFP after receipt of the RFP, submit to the Owner's Representative a complete proposal estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

1. Proposal Number: The proposal number shall match the RFP number to which it corresponds or be clearly noted on the coversheet of the proposal.

2. Required Statements: The Contractor shall include the following statement above their signature line on the proposal coversheet: "By the signature below, the Contractor (insert name of Contractor) certifies that they have reviewed, verified, and validated all the pricing submitted in this proposal and that it is consistent with the scope of the RFP unless specifically noted above."

3. Signature Line: Under the Approval/Acceptance signature line on each proposal, the Contractor shall include the following verbiage: CCPS.

4. Due Date: The Contractor must submit their proposal by the due date shown on the corresponding RFP unless otherwise noted. At the Owner's option, the Owner's Representative can send the Contractor notice requiring a proposal to be submitted within ten (10) additional calendar days. If the Contractor fails to provide complete and valid pricing, the Owner's Representative shall estimate the cost and/or time extension of the proposed change in the Work. The Contractor shall be required to accept this estimated cost and/or time extension and shall forgo any and all other cost recovery, compensation, and/or time extension related to the proposed change in the Work.

5. RFP: The proposal shall contain a copy of the RFP including all 8½" x 11" sheets issued with the RFP. Large sheet drawings shall be excluded.

6. Summary Sheet: The Contractor shall provide a summary sheet individually listing all the Contractor and Subcontractor costs included in the proposal. The Contractor's fee shall be shown as a separate line item in the summary.

7. Subcontractor Backup: Subcontractor backup shall be provided with sufficient itemization and breakdown to support the proposed cost including material quotes from suppliers or manufacturers. Lump sum proposals shall not be accepted unless the value of the work is less than $1,000, or otherwise approved by the Owner's Representative.

8. Work Tickets: Daily work tickets specifying the work performed, material, labor, and/or material quantities shall be provided for RFP's performed on a Time and Material or Unit Price basis. Daily work tickets can also be provided as supporting documentation for RFP's issued with different pricing direction. Testing & Inspection daily reports shall be provided for RFP's requiring sitework material quantification.

9. Completeness: Regardless of any blanket or generic exceptions or claims to future time or cost related to the proposal, the Contractor's proposal is to fully contain any and all cost and/or time extensions to implement the work specified in the RFP.

10. Clarifications: The Owner and Owner's Representative are entitled to rely on the Contractor's proposal that it is fully consistent with the RFP scope. Any material

deviations or substitutions shall be clearly noted by the Contractor on the proposal coversheet.

11. 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. The Owner's Representative will review each proposal and will negotiate the proposal amount and any time extensions as required on behalf of the Owner. Final approval of proposals is subject to the Owner's review and acceptance.

1.6 BUDGETING

A. At the end of each month, the Contractor shall provide the Owner's Representative with a non-binding, good faith cost estimate for each open RFP.

1.7 CHANGE ORDER PROCEDURES

A. On Owner's approval of the Contractor's proposal, the Owner's Representative will issue a Change Order for signatures of Owner, Owner's Representative, and Contractor on AIA Document G701.

B. Change Orders will be prepared on a monthly basis with all approved proposals to date.

1.8 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: The Owner's Representative may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. 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

SECTION 013100 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1. Coordination Drawings.
2. Administrative and supervisory personnel.
3. Project meetings.
4. Requests for Information (RFI's).
5. Intermediate Milestones and Coordination
6. Required and recommended software and hardware.
7. Third Party Inspections.
8. Safety Plan

B. Related Sections include the following:

1. Division 1 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
2. Division 1 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Division 1 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.4 COORDINATION

A. Coordination: The Contractor shall 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. Carefully examine all architectural and structural drawings for the building and the drawings for electrical, mechanical, and other trades. Be responsible for the proper fitting of all materials and equipment into the building as planned, without interference with piping, equipment, and conduit and to overcome all local difficulties and interferences to the best advantage. Coordinate construction phasing as required.

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 with other contractors to ensure maximum accessibility for required maintenance, service, and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.

4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

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 and activities of other contractors 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. Startup and adjustment of systems.
8. Project closeout activities.

1.5 SUBMITTALS

A. Coordination Drawings:

1. Submittals shall be formally submitted through a method to be established or approved by the Owner. Any submittal issued by other means shall not be reviewed until submitted appropriately. Owner reviews and color selections are not official until the formal submittal review is returned. Contractor shall follow Owner's submittal numbering standard.

2. Submit coordination drawings prior to preparation of shop drawings. Extensions of time will not be granted for delays caused by inadequate or poorly prepared coordination drawings. Failure to submit coordination drawings shall constitute a waiver of claims for additional costs associated with relocation of fixtures, equipment, and appurtenances.

3. Form of submittal shall be as described for shop drawings in Division 01 of this Project Manual.

4. Prepare coordinated composite layouts of mechanical and electrical equipment, mechanical rooms, electrical closets, rooftop equipment, ceiling and plenum spaces, etc.

Drawings shall be drawn at not less than 1/4" = 1'-0" scale. Show both, plans and elevations, equipment, ducts, main piping including plumbing, special supports and other items contained within space. Show mechanical, electrical, structural, and architectural features.

a. Prepare coordination drawings to organize installation of products for an efficient use of available space, for proper sequence of installation, and to identify potential conflicts. Coordination drawings shall be clearly dimensioned and shall show work of all trades, correctly scaled, in affected areas. Key and cross-reference coordination drawings to Contract Documents.

b. Sizes and bottom elevations shall be shown for rectangular ductwork; sizes and centerline elevations shown for round ductwork and piping. Major components, such as dampers, valves, and clean-outs shall be dimensioned from column centerlines.

c. Double lines shall be shown for ductwork and pipes 6" and larger. Single lines shall be shown for lines less than 6" in size.

d. Coordination drawings shall show offsets, fittings, and other similar items that may interfere with work of other trades in areas covered by coordination drawings. Prepare coordination drawings so that work will be installed without interference, within dimensional limitations indicated, with proper clearances, and will meet requirements of Contract Documents with no additional cost to Owner.

e. Dimensions shall be field verified to greatest extent possible.

5. Submit a coordinated sleeve drawing for each day's pour indicating exact size, location, and material of sleeve openings, duct openings, conduit stub-ups, etc. in cast-in-place concrete. Drawings shall be drawn at not less than 1/4" = 1'-0" scale. Sleeve drawings shall be submitted at least 4 weeks prior to fabrication of reinforcing steel. No slabs shall be poured prior to acceptance of sleeve drawings.

   a. Refer to specific sections for concrete formwork, concrete reinforcement, cast-in-place concrete, and post-tensioned concrete for detailed information and additional information.

6. After review of coordination documents by Owner, reproduce and distribute copies to concerned parties.

7. Maintain documents for duration of Work, recording changes due to instructions, modifications, or adjustments.

8. Work above ceilings shall be installed per Coordination drawings so that all work is properly concealed above ceilings heights indicated in the drawings and allows for proper access for maintenance as required. Coordination for making sure everything will fit above ceilings is intended to be done with the coordination drawings. If contractor discovers any issues w

B. Key Personnel Names: Within thirty (30) 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 and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in temporary field office, and by each temporary telephone. Keep list current at all times.

1.6 PROJECT MEETINGS

A. Preconstruction Conference:

1. The Owner's Representative may schedule a pre-construction meeting at the project site or Owner's office prior to commencement of construction activities.

2. Attendees: Authorized representatives of Owner, Owner's Representative; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: The Owner's Representative will prepare the agenda to include items of significance that could affect progress, including the following:

   a. Distribution and flow of information.
   b. Roles and responsibilities of Project participants.
   c. Construction schedule.
   d. Critical work sequencing and long-lead items.
   e. Requests for Information.
   f. Request for Proposals.
   g. Procedures for testing and inspecting.
   h. Procedures for processing Applications for Payment.
   i. Distribution of the Contract Documents.
   j. Submittal procedures.
   k. Substitutions.
   l. Procedures for maintaining Project Record Documents
   m. Use of the premises and existing building.
   n. Work restrictions.
   o. Owner's occupancy requirements.
   p. Responsibility for temporary facilities and controls.
   q. Construction waste management and recycling.
   r. Parking availability.
   s. Office, work, and storage areas.
   t. Temporary facilities
   u. Equipment deliveries and priorities.
   v. Security.
   w. Progress cleaning.
   x. Working hours.
   y. Permits, licenses, and inspections.

4. Minutes: The Owner's Representative will record and distribute meeting minutes.

B. Progress Meetings:

1. The Owner's Representative may schedule and administer Project Meetings to be held at Site and/or remotely, throughout the progress of Work at intervals appropriate to progress of Work. Special meetings may also be called at discretion of Owner for purpose of coordinating specific information or resolving special problems related to Project.

2. The Contractor shall make physical arrangements for the meetings. The Owner's Representative shall prepare agenda, preside at meetings, record minutes, and distribute copies of minutes.

3. Attendees: The following parties shall be represented at the meeting:

   a. Owner
   b. Contractor's Project Manager
   c. Contractor's Project Superintendent
   d. Subcontractors as deemed appropriate

4. Agenda: The Owner will prepare the agenda to include all current issues. Scheduled agenda may include:

   a. Review of previous meeting minutes (old business).
   b. New or pending design issues.
   c. Review specific coordination or construction issues.
   d. Quality and work standards.
   e. Status of correction of deficient items.
   f. Field observations.
   g. Review status of request for information.
   h. Review status of submittals.
   i. Permanent utilities.
   j. Construction issues.
   k. Review progress of the Work.
      1) Work plan and construction schedule.
      2) Delivery Schedules.
      3) Milestone dates.
   l. Request for proposals and Change Orders.
   m. Testing and inspection services.

5. Required Documentation:

   a. The Contractor shall submit copies of the following documents at each Progress Meeting for all attendees:
      1) Request for Information Log
      2) Submittal Log
      3) Progress update since last meeting
      4) Two week look ahead schedule
      5) Full Construction Schedule updated a minimum of once per month
      6) Request for Proposal Log
      7) Superintendent Daily Field Reports (one copy to be provided to Owner's Representative)

6. Minutes: The Owner will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Assemblies: At a minimum Preinstallation Conferences should be scheduled for the following major assemblies, although the Owner can require additional Preinstallation Conferences for other assemblies:

   a. Waterproofing
   b. Exterior Envelope/Skin

c. Roofing/Flashing
d. Interior Finishes
e. Cast-in-Place Concrete

2. 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 Owner's Representative of scheduled meeting dates.

3. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

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

4. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

5. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including the Owner and Contractor.

6. 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. Coordination Meetings: Conduct Project coordination meetings as needed. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of the Owner, 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 conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

   a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to Combined 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.

   b. Schedule Updating: Revise Combined Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.

   c. Review present and future needs of each contractor present, including the following:

      1) Interface requirements.
      2) Sequence of operations.
      3) Status of submittals.
      4) Deliveries.
      5) Off-site fabrication.
      6) Access.
      7) Site utilization.
      8) Temporary facilities and controls.
      9) Work hours.
      10) Hazards and risks.
      11) Progress cleaning.
      12) Quality and work standards.
      13) Change Orders.

3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Contractor.

E. Closeout Meeting

1. The Owner's Representative may schedule and administer Closeout Meetings to be held at Site once Substantial Completion of the project has been achieved.

2. The Contractor shall make physical arrangements for the meeting. The Owner's Representative shall prepare agenda, preside at meeting, record minutes, and distribute copies of minutes.

3. Attendees: The following parties shall be represented at the meeting:

   a. Owner
   b. Contractor's Project Manager
   c. Contractor's Project Superintendent
   d. Subcontractors as deemed appropriate

4. Agenda: The Owner will prepare the agenda to include all current issues. Scheduled agenda will include:

    a. Review of previous meeting minutes (old business).
    b. Comprehensive Closeout List
    c. Building and system commissioning requirements.
    d. Review status of punchlist.
    e. Review status of closeout documentation.
        1) Warranty letters.
        2) Record product data and material samples.
        3) Record as-built drawings and specifications.
        4) Attic stock.
    f. Equipment and systems demonstrations and training.
    g. Miscellaneous work and backordered items.
    h. Open RFP's.

5. Required Documentation:

    a. The Contractor shall issue an updated Comprehensive Closeout List to all attendees.

6. Minutes: The Owner will record and distribute meeting minutes.

1.7 REVISIONS TO MEETING MINUTES

A. Unless published minutes are challenged in writing within three business days of issuance, they will be accepted as properly stating the activities and decisions of the meeting.

B. Persons challenging published minutes shall reproduce and distribute copies of the challenge to all indicated recipients of the particular set of minutes.

C. Revised meeting minutes shall be distributed after resolution of the challenged item(s).

1.8 REQUESTS FOR INTERPRETATION (RFI's)

A. When Contractor is unable to determine from Contract Documents, material, process, or system to be installed, the Owner shall be requested to make a clarification of indeterminate item.

1. RFIs shall be formally submitted through a procedure determined or approved by the Owner. Any RFIs issued and resolved by phone or email are to be immediately followed-up with a formal RFI for documentation – responses are not official or binding until the formal RFI is returned. Contractor shall follow the Owner's RFI numbering standard. No RFIs are to be sent directly to other members of the design team. No extensions of time will be given due to time taken for written or verbal responses to RFIs by the Owner.

2. Contractor shall limit each RFI to one particular topic.

B. RFI's shall be submitted on a form acceptable to Owner's Representative. Forms shall be completely filled in, prepared electronically, and digitally submitted.

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

1. Project name.
2. Date.
3. Name of Contractor.

4. Name of Architect.
5. RFI number, numbered sequentially.
6. Subject label.
7. Specification Section number and title and related paragraphs, as appropriate.
8. Drawing number and detail references, as appropriate.
9. Field dimensions and conditions, as appropriate.
10. Contractor's suggested solution(s).
11. Potential Contract Time or Contract Sum impact - Yes/No
12. Contractor's signature.
13. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

    a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

D. RFI's shall be originated by the Contractor.

1. RFI's from subcontractors or material suppliers shall be submitted through, reviewed by, and signed by Contractor prior to submittal to the Owner.

2. RFI's from subcontractors or material suppliers sent directly to Owner and/or his/her consultants shall not be accepted and will be returned unanswered.

E. Contractor shall carefully study Contract Documents to assure that requested information is not available therein. RFI's which request information available in Contract Documents will be deemed frivolous and returned unanswered. Time dedicated to the investigation of RFIs which request information available in the contract documents will be tracked and charged to the contractor.

F. In cases where RFI's are issued to request clarification issues, for example, pipe or duct routing, clearances, specific locations of work shown diagrammatically, and similar items, Contractor shall fully layout a suggested solution using drawings or sketches drawn to scale, and submit with RFI.

G. Owner's Action: Owner will review each RFI, determine action required, and return it. Allow ten (10) working days for Owner's response for each RFI. RFI's received after 2:00 PM will be considered as received the following working day.

1. The following RFIs may be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for coordination information already indicated in the Contract Documents.
    d. Requests for adjustments in the Contract Time or the Contract Sum.
    e. Requests for interpretation of Owner's actions on submittals.
    f. Incomplete RFI's or RFI's with numerous errors.

2. Owner's action may include a request for additional information, in which case Owner's time for response will start again upon receipt of the requested information.

3. In event Contractor believes that a clarification by The Owner results in a change to the Contract Time or the Contract Sum, Contractor shall not proceed with work indicated by

RFI until an RFP is issued by the Owner's Representative. RFI's shall not automatically justify a cost increase in work or a change in Project Schedule.

a. If Contractor believes the RFI response warrants a change in the Contract Time or the Contract Sum, notify Owner's Representative in writing within five (5) days of receipt of the RFI response.

b. Answered RFI's shall not be construed as approval to perform extra work. Contractor shall not proceed with any change in the Work unless formally authorized by the Owner's Representative.

H. On receipt of the Owner's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify the Owner within seven (7) working days if Contractor disagrees with response.

I. RFI Log: Prepare, maintain, and submit a tabular log of RFI's organized by the RFI number. Submit log at each Progress Meeting or at intervals as stipulated by the Owner's Representative.

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFI's that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date the Owner's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.9 INTERMEDIATE MILESTONES AND COORDINATION

A. The Contractor shall include the following intermediate milestones in their construction schedule:

1. Coordination with Owner and School activities as required.

B. Furnishings, Fixtures, and Equipment: Coordinate and permit the Owner to install his furnishing, fixtures, and equipment during the progress of the work. Owner's installation of furnishing, fixtures, and equipment, does not signify Owner's acceptance of any portion of the work.

1.10 REQUIRED AND RECOMMENDED SOFTWARE AND HARDWARE

A. Required Software: The Contractor is required to own and use the following software in the current version as indicated:

1. Adobe Acrobat Reader DC: The purpose of this software is to read *.PDF files (Portable Document Files) created by Adobe Acrobat.

2. Adobe Acrobat: The purpose of this software is to create, read, and exchange documents with the original appearance preserved.

3. MS Project or equivalent: This software shall be used for all construction scheduling so that it can be shared with the entire project team.

4. General Email Program and Internet Access: The general purpose of an email program and Internet access is to send and receive electronic communication and files. Email shall be used to the fullest extent possible to reduce paper correspondence.

5. MS Windows compatible zip/unzip utility program: The purpose of this software is to open and create packaged and minimized electronic files.

B. Recommended Software: It is recommended that the Contractor own and use the following software in the version as indicated or newer release:

1. AutoCad 2013 or later: The purpose of this software is to open and read electronic CAD drawings.

C. Required Hardware: The Contractor is required to own and use a scanner to scan documents and issue them electronically as PDF files.

1.11 Third Party Inspections

A. The Contractor shall acquire and pay the cost of Third-Party Inspections/inspectors who will become the Owner's Representative as pertains to meeting engineering requirements & installation (capacities, material strengths and proper assembly to achieve design performance & perimeters). Refer also to Division 1 notes on drawing sheet S-1.

B. The Third-Party Inspector shall perform water and sewer line testing as required by the specifications and water bacterial testing as required by code.

1.12 Safety Plan

A. Safety Plan must be submitted in writing for review and approval by the Owner through the normal submittal process.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013200 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1. Submittals Schedule.
2. Scheduling of Construction
3. Daily Construction Reports.
4. Special Reports.

B. Related Sections include the following:

1. Division 1 Section “Payment Procedures” for submitting the Schedule of Values.
2. Division 1 Section “Project Management and Coordination” for submitting and distributing meeting and conference minutes.
3. Division 1 Section “Submittal Procedures” for submitting schedules and reports.
4. Division 1 Section “Photographic Documentation” for submitting construction photographs.

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 activities are activities on the critical path. They 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. 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 when activities can be performed and the critical path of Project.

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

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

E. 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.

F. Major Area: A story of construction, a separate building, or a similar significant construction element.

G. Milestone: A key or critical point in time for reference or measurement.

1.4 SUBMITTALS

A. Submittals Schedule: Submit schedule digitally. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.
6. Scheduled date for Owner's final release or approval.

B. Daily Construction Reports: Submit one to Owner's Representative on a weekly basis.

C. Special Reports: Submit at time of unusual event.

1.5 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

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

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.

2. Initial Submittal: Submit concurrently with preliminary construction schedule. Include submittals required during the first sixty (60) days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 SCHEDULING OF CONSTRUCTION

A. Contract Schedule:

1. Contract Schedule is document that controls timely execution of Work. It is initially defined by number of workdays listed in Contract Documents for completion of each milestone and for completion (in calendar days) of Work.

2. Upon submittal and acceptance, by Owner of Preliminary Construction Schedule, Preliminary Construction Schedule becomes Contract Schedule.

3. Upon submittal and acceptance, by Owner, of Detailed Construction Schedule, Detailed Construction Schedule becomes Contract Schedule.

4. Upon acceptance by Owner of mutually agreed change orders, that amend Detailed Construction Schedule, most current such accepted amended version of Detailed Construction Schedule becomes Contract Schedule.

B. Preliminary Construction Schedule:

1. Not less than fifteen (15) days prior to date established for commencement of construction (either by Letter of Intent or Notice to Proceed, whichever is earlier), prepare and submit for Owner's Representative's information and review a Preliminary Construction Schedule for Work.

2. Schedule shall:

a. Show sequence of construction and related administrative activities.

b. Differentiate between interdependent and independent construction activities.

c. Identify project milestones, such as sub-phases, substantial completion, completion, and occupancy.

d. Contain detail activities for first 60 days of construction and summary activities for period after the first 60 days until end of Project. Work for each phase or area shall be represented by at least one summary activity such that schedule indicates entire Work.

e. Include time for expected delays based on the average for monthly inclement weather of the region in which the project is located (as determined by the National Weather Service).

3. Key Item Procurement:

    a. For major equipment and materials and long-lead (over 12 weeks from order placement to delivery) items fabricated or supplied for Work, include in Preliminary Construction Schedule a tabular report detailing these items and indicating schedule dates for following related activities:
        1) Preparation and review of submittals
        2) Manufacture or fabrication
        3) Shipment and delivery
        4) Receipt
        5) Erection or installation
        6) Testing and inspection

4. Tabulation of Submittals:

    a. Include in Preliminary Construction Schedule a tabulation by date of submittals needed during first 60 days of construction.

    b. List those needed to maintain orderly progress of Work, and those needed early because of long lead-time for manufacture or fabrication.

5. Distribution:

    a. Provide digital copy to Owner's Representative. Also distribute schedule to subcontractors and suppliers that need to know about timing of these construction activities.

C. Detailed Construction Schedule:

1. Not later than 30 days after to date established for commencement of construction prepare and submit for the Owner's information and review a Detailed Construction Schedule for Work.

2. Proceed with preparation of Detailed Construction Schedule immediately following notification of Contract award.

3. Submit a computer generated network analysis diagram using critical path method, generally outlined in Associated General Contractors of America publication, *The Use of CPM in Construction - A Manual for General Contractors and the Construction Industry*.

    a. The Contractor shall use MS Project to manage CPM construction schedules.

4. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities.

    a. Activity duration over 15 working days or $20,000 in value shall be kept at a minimum except in case of non-construction activities.

    b. Indicate early and late start, early and late finish, float dates, and duration. Beginning and end of each activity shall be readily observable and verifiable during execution of Work.

    c. Indicate important work features or operations that are critical to timely overall completion of Project.

d. Indicate submittal dates needed for shop drawings, product data, samples, and product delivery dates, including those furnished by Owner and under allowances.

e. Key dates for such important work features and portions of work features are milestone dates and shall be so indicated on schedule.

5. Project milestone dates are considered essential to satisfactory performance of this Contract and to coordination of work on Project. Project milestone dates may include:

a. Contract award
b. Notice to proceed
c. Project mobilization, as well as onsite work
d. Meetings, pre-application conferences, and mock-ups
e. Submittals for components with extended lead times
f. Holidays and make-up dates
g. Commencement, duration, and completion of each major activity
h. Start-up and testing of major systems, as well as demonstration and training
i. Work by Owner and separate Owner contracts (when applicable)
j. Key inspections and Substantial Completion
k. Project de-mobilization and completion

D. Updating Schedules:

1. Schedule shall be kept current and updated on not greater than a monthly basis for presentation at periodic progress meetings or as designated by Owner. Submit revised schedules identifying changes since previous version. Schedule updates shall include:

a. Actual start dates
b. Actual completion dates
c. Activity percent completion
d. Changes in activity duration
e. Influence of change orders
f. Contractor acknowledges that updating Contract Schedule to reflect actual progress made as of date of update is not a modification to Contract Schedule's milestone requirements.

2. Distribution:

a. Provide to Owner's Representative for informational purposes only.

b. Distribute schedule to subcontractors and suppliers that need to know about timing of these construction activities.

c. A copy of current Contract Schedule shall be maintained at all time on-site.

3. Owner's acceptance in no way makes Owner or its representative's insurers of success of Contractor's time performance or liable for time or cost overruns flowing from shortcomings of Contractor authored Contract Schedule. Owner disclaims and Contractor waives any Owner obligation or liability by reason of Owner's acceptance of or acquiescence to Contractor's schedule submissions.

4. Delays:

a. The Contractor agrees that wherever it becomes apparent from the current monthly CPM schedule update that delays to the critical path have resulted and, hence, that the Contract completion date will not be met, or when so directed by the Owner, he will take some or all of the following actions at no additional cost to the Owner:
   1) Increase construction manpower in such quantities and crafts as will substantially eliminate the backlog of work.
   2) Increase the number of working hours per shift; shifts per working day, or days per week; the amount of construction equipment; the forms for concrete work; or any combination of the foregoing to substantially eliminate the backlog of work.
   3) Reschedule activities to achieve maximum practical concurrency of accomplishment of activities, and comply with the revised schedule.
   4) The Contractor shall submit to the Owner's Representative for review, a written statement of the steps he intends to take to remove or arrest the delay to the schedule. If the Contractor shall fail to submit a written statement of the steps he intends to take or should fail to take such steps as required by the Contract, the Owner may direct the level-of-effort in manpower (trades), equipment, and work schedule (overtime, weekend and holiday work, etc.) to be employed by the Contractor in order to remove or arrest the delay to the critical path in the accepted schedule, and the Contractor shall promptly provide such level-of-effort at no additional cost to the Owner. In addition, should schedule delays persist, the Contractor's bond agent will be asked to attend meetings to update the schedule.
   5) Should it be deemed necessary, in the Owner's sole discretion, that delays or incomplete work have warranted the use of outside sources to arrest a delay or to complete incomplete work, the Owner reserves the right to back charge the Contractor for all costs incurred by the use of outside sources.

b. Time extensions for weather delays affecting the critical path will not be approved until after the average time built into the project schedule for inclement weather is first used. The average time for inclement weather is to be based on the average amount of monthly inclement weather of the region in which the project is located (as determined by the National Weather Service). This will be assessed on a cumulative monthly basis throughout the project.

c. Weather delays not affecting the critical path will not be considered as a reason for a time extension.

2.3 DAILY CONSTRUCTION REPORTS

A. 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.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (refer to special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.

14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial Completions and occupancies.
19. 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.

2.4 SPECIAL REPORTS

A. General: Submit special reports directly to Owner and Owner's Representative within one (1) day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: 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, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner and Owner's Representative 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 3 - NOT USED

END OF SECTION

SECTION 01 33 00 – SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1. DESCRIPTION

A. Work included: Make submittals required by the Contract Documents to the Owner, and revise and resubmit as necessary to establish compliance with the specified requirements.

B. Related Work

1. 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.
2. In addition to other requirements specified, upon the Owner's request uncover work to provide for inspection by the Owner of covered work, and remove samples of installed materials for testing.
3. Do not cut or alter work performed under separate contracts without the Owner's written permission.
4. Individual requirements for submittals also may be described in pertinent Sections of these Specifications.
5. Maintain a record document set of all approved submittal documents. See Section 017839.

C. Work not included

1. Submittals not required will not be reviewed by the Owner.
2. The Contractor may require his Subcontractors to provide drawings, setting diagrams and similar information to help coordinate the Work, but such data shall remain between the Contractor and his Subcontractors and will not be reviewed by the Owner.

D. Minor modifications

1. Any minor modifications to dimensions, details, or other project requirements must be clearly and conspicuously identified in the submittal for Owner review. It is imperative that the contractor include a WRITTEN RATIONALE on the submittal for any deviation, however minor, so that the Owner can understand the reason behind the deviation and review accordingly. If the rationale for a modification is not apparent, the Owner may reject the submittal and require resubmission due to noncompliance with the contract documents, requiring additional turnaround time and review.

1.2. QUALITY ASSURANCE

A. Coordination of submittals

1. Prior to each submittal, the General Contractor is to carefully review and coordinate all aspects of each item being submitted and have the Sub-Contractor revise the submittal as needed to correct errors prior to submitting to Owner.
    a. Verify that each item and the submittal for it conforms in all respects with the specified requirements.

b. Substitution of materials for those specified will not be permitted in submittals.

c. If drawings show variations from Contract requirements because of standard shop practice or for other reasons, the Contractor shall describe such variation in his letter of transmittal. All variations must be brought to the attention of the A/E clearly and conspicuously. If the Contractor fails to describe such variation, or if the A/E does not specifically indicate that the variation is acceptable, the Contractor shall not be relieved of the responsibility for executing the Work in accordance with the Contract, even though such drawings have been approved.

d. Verify all field measurements and conditions prior to submission.

e. By affixing the Contractor's signature to each submittal, certify that this coordination has been performed.

f. Each submittal shall be certified by the Contractor with the following stamp:

"This is to certify that the specification requirements have been met and all dimensions, conditions and quantities are verified as shown and/or corrected on these drawings.

Signed for _____ Contractor"

1.3. SUBMITTALS

A. Make submittals of Shop Drawings, Samples, and other items in accordance with the provisions of this Section.

B. Units of measurement on submittals shall be in the Imperial system.

1.4. RETURN OF SHOP DRAWINGS TO CONTRACTOR.

A. Shop drawings shall be returned electronically via the Project Construction Database software.

B. As needed, physical shop drawings and samples will be returned to the Contractor at the site during scheduled progress meetings or delivered to the Contractor at the expense of the Contractor, if Contractor does not make arrangements to have shop drawings and samples picked up at the office of the Owner.

PART 2 - PRODUCTS

2.1. SHOP DRAWINGS

A. Scale and measurements: Make Shop Drawings accurately to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to the Work.

B. Types of prints required

1. Submit Shop Drawings electronically in PDF format.
2. Unless absolutely necessary, the size of Shop Drawings shall not exceed 42" x 30". Provide space on all Drawings for approval stamps and brief review comments.
3. Blueprints will not be accepted.

C. Review comments of the Owner will be shown when it is returned to the Contractor. The Contractor may make and distribute such copies as are required for his purpose.

D. Electronic Submittals: Electronic Submittals are acceptable, review comments will be incorporated in the returned electronic submittal. Contractor is required to maintain (1) hard copy of the submittals on site and accessible to the owner and trades at all times.

2.2. MANUFACTURERS' LITERATURE

A. Manufacturers' data shall be defined to include, but not be limited to, catalogue cuts, technical descriptive brochures, performance charts, test reports, writing diagrams, details, specifications, and other printed literature or bulletins issued or provided by the product manufacturers. Upon receipt, the Owner will mark corrections, stamped copies, and return those additional copies to the Contractor. If resubmittal is necessary, repeat process until approval has been obtained.

B. Manufacturers' data for equipment: Include materials, type, performance, characteristics, voltage, phase, capacity, and similar data. Provide wiring diagrams when applicable. Submittals indicating catalogue, model, and serial numbers representing specified equipment will be assumed to comply with the Contract Documents in all respects.

C. Where contents of submitted literature from manufacturers includes data not pertinent to the submittal, clearly show which portions of the contents is being submitted for review.

2.3. SAMPLES

A. Provide Sample or Samples identical to the precise article proposed to be provided. Identify as described under "Identification of Submittals" below.

B. Number of Samples required

1. Unless otherwise specified, submit Samples in the quantity which is required to be returned, plus one which will be retained by the Owner.

2. By prearrangement in specific cases, a single Sample may be submitted for review and, when approved, be installed in the Work at a location agreed upon by the Owner.

2.4. COLORS AND PATTERNS:

A. Unless the precise color and pattern is specifically called out in the Contract Documents, and whenever a choice of color or pattern is available in the specified products, submit accurate color and pattern charts to the Owner for selection.

2.5. EQUIPMENT OPERATING AND MAINTENANCE DATA:

A. Provide Operating, Maintenance and Product data manuals as described in Section Division 01 of these Specifications.

2.6. UTILITY APPROVALS:

A. Approval of utilities or other public authorities having jurisdiction shall be obtained and reflected on all affected submittals.

2.7. DEVIATIONS FROM CONTRACT DOCUMENTS:

A. Clearly mark all deviations in a conspicuous manner indicating component and system variations, additions and deletions, revised equipment locations, construction detail variations, substitutions, and similar changes or deviations. Indicate headroom heights, ceiling heights, clearances, and other dimensions affected by proposed deviations. All variations from the Contract Documents not specifically and conspicuously brought to the

attention of the Owner, or for which the Owner does not specifically indicate acceptance, shall be the sole responsibility of the Contractor even though such submittal has been accepted.

2.7 CERTIFICATION:

A. Provide such certification as is required per pertinent sections of these specifications. A minimum of two originals and one copy of the certification shall be forwarded.

PART 3 - EXECUTION

3.1. IDENTIFICATION OF SUBMITTALS

A. Consecutively number all submittals. Submittal number format will follow the Owner's preferred standard.

B. Accompany each submittal with a letter of transmittal showing all information required for identification and checking. Letter of transmittal shall indicate submittal number and make reference to the applicable drawing numbers and specification sections to which each submittal applies.

C. On at least the first page of each submittal, and elsewhere as required for positive identification, show the submittal number in which the item was included and make reference to the applicable drawing numbers and specification section to which the submittal applies.

D. Each submittal should indicate supplier/installer's name, phone number and the specific location(s) of the submitted product in the project.

E. Resubmittals

1. When material is resubmitted for any reason, transmit under a new letter of transmittal and with a new transmittal number.

2. On resubmittals, cite the original submittal number for reference on the letter of transmittal and submittal.

3. All changes should be clearly designated as to revisions made. No consideration will be allowed for submittal revision labor made to coordinate revised, changed, adjusted details or scope of Work.

F. Maintain an accurate submittal log for the duration of the Work, showing current status of all submittals at all times. Make the submittal log available to the Owner for his review upon request.

G. The Contractor shall avoid including multiple items under one submittal number.

3.2. GROUPING OF SUBMITTALS

A. Unless otherwise specified, make submittals in groups containing all associated items requested in each Specification Section to assure that information is available for checking each item when it is received.

1. Partial submittals may be rejected as not complying with the provisions of the Contract.

2. The Contractor may be held liable for delays so occasioned.

3.3. TIMING OF SUBMITTALS

A. The Contractor shall submit within one (1) week of Contract award a submittal schedule listing all submittals and proposed dates of each submittal, and lead time for each item with particular note of priority items to be reviewed. All submittals shall be submitted in an orderly sequence matching the sequence of construction and lead times required and shall be staggered so as to evenly spread out the quantity of submittals so they can be reviewed by Owner in a timely manner. Allow time for potential resubmittal(s) when developing the submittal schedule. The submittal schedule shall be reviewed and approved by the Owner prior to processing or approving any other submittals, however, the Contractor remains solely responsible for scheduling and sequencing submittals in an timely manner.

B. All submittals by the General Contractor should be made within 90 days of the Notice to Proceed and/or far enough in advance of scheduled dates for installation to provide time required for reviews, for securing necessary approvals, for possible revisions and resubmittals, and for placing orders and securing delivery.

C. Where it is shown that the Contractor has neglected to submit shop drawings on a timely basis or to place his orders for materials and labor early enough to conform with materials and labor requirements, color schemes, etc., such failure shall not be deemed as legitimate cause for delay.

D. In scheduling, allow at least fourteen (14) working days for review by the Owner following his receipt of the submittal. Submittals received after 12pm may be counted as received the following business day.

3.4. OWNER'S REVIEW

A. Review by the Owner does not relieve the Contractor from responsibility for errors that may exist in the submitted data.

B. Revisions

1. Make revisions required by the Owner.

2. If the Contractor considers any required revision to be a change, he shall so notify the Owner as provided for in the General Conditions.

3. Make only those revisions directed or approved by the Owner.

C. Owner's approval

1. Until approval has been given by the Owner, any materials or items to be so approved must not be fabricated or incorporated in the Work. The Owner's approval will be only general in nature and shall not be construed as permitting any departure from Contract requirements, or as relieving the Contractor of responsibility for any errors concerning details, dimensions, materials, etc. If drawings show variations from Contract requirements because of standard shop practice or for other reasons, the Contractor shall describe such variation in his letter of transmittal. If acceptable, the Owner may approve any or all such variations, subject to proper adjustment in Contract price. If the Contractor fails to describe such variation, he shall not be relieved of the responsibility for executing the Work in accordance with the Contract, even though such drawings have been approved.

2. Acceptance shall not be construed as a complete check but will indicate only that the general method of design, fabrication, and detailing is consistent with the design intent and that errors and discrepancies observed when reviewed have been noted. Acceptance of a separate item shall not be interpreted as an

approval of an assembly in which the item functions. The right is reserved by the Owner to require submission of additional detail, shop, erection or setting drawings and of any schedules for any part of Work, whether or not specifically mentioned in the Project Specifications, where substitutions or modifications are proposed by the Contractor, or where such information is essential to the proper assembly, coordination or execution of Work under the Contract.

3. Review and acceptance shall not relieve the Contractor from responsibility for errors in shop drawings or for proper coordination assembly of materials and equipment with other Work, nor from the responsibility of furnishing materials and labor not indicated on approved shop drawings, but required by the Contract Documents for completion of Work.

END OF SECTION

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 Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.
4. Specific test and inspection requirements are not specified in this Section.

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: 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 trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface

between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged and will be considered a minimum quality for level of Work.

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.

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: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.

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

I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

J. 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.

K. 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 Owner.

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 Owner.

B. Delegated design services include, but are not limited to structural steel, curtain wall and cold formed metal framing shop drawings. Refer also to individual Sections for additional requirements.

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, comply with the most stringent requirement and the higher quality or cost. Refer conflicting requirements that are different, but apparently equal, to Owner for direction before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be 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 Owner for a decision before proceeding.

1.6 ACTION SUBMITTALS

A. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, 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.

1.7 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. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
   1. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

D. 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.

E. 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.

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

G. 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: Submit quality-control plan within 10 days of Notice of Award and not less than 5 days prior to preconstruction conference. Submit in format acceptable to Owner. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. 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. Do not change approved Quality Control Personnel after project has begun unless approved. Compensation to the Owner of $10,000 for lost productivity will be assessed to the Contractor for changes in Quality Control Personnel after approval of Quality Control Personnel has been provided.

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

E. 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”.
3. Owner reserves the right to hire their own inspectors.

F. 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 work into compliance with standards of workmanship established by Contract requirements and approved mockups. Include work Owner has indicated as non-conforming.

G. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Owner 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 as required: 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 whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports as required: 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 whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.10 QUALITY ASSURANCE

A. General: 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.

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. Contractor/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 are similar in material, design, and extent to those indicated for this Project.

F. Quality-Control Plan System Manager: The Quality-Control Plan System Manager shall be:

1. An experienced construction person with a minimum of 10 years' experience in construction management; 5 years of which must be in Quality-Control Plan, and ;
2. Shall be assigned no other duties on this or any other job; and
3. Shall not be the Contractor's superintendent for the project.

G. Specialists: Certain Specification Sections may require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

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

H. Supplemental Personnel: The Contractor must provide as part of the Quality-Control Plan organization, as a minimum, specialized personnel for the following areas:

1. HVAC Quality Control – HVAC review for compliance with Contract Documents quality, and applicable codes.
2. Electrical Quality Control: Electrical review for compliance with Contract Documents, quality and applicable codes.
3. Building envelope (including roofing) Quality Control – Inspect and evaluate the building envelope systems for compliance with Contract Documents, quality and applicable codes.
4. These personnel shall assist and report to the Quality-Control Plan System Manager. Each person will be responsible for assuring the construction complies with the Contract Documents for their area of specialization. These individuals shall:
   a. be employed by the Contractor or employed on a consultant basis, unless waived in writing by the Owner's Project Manager;
   b. be responsible only to the Quality-Control Plan System Manager;
   c. be physically present at the site during work on their areas of responsibility;
   d. have the necessary education, training and experience to ensure Contract compliance; and not be the employee of any of the subcontractors.
5. A Commissioning Authority may be retained by the Owner. The Quality-Control Plan System Manager will work with the Commissioning Authority to provide all access, documents, information, subcontractor testing and involvement needed to successfully commission the facility systems.

I. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

J. 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.

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

L. 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:

1. Contractor responsibilities include the following:

    a. Provide test specimens representative of proposed products and construction.
    b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
    d. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
    e. When testing is complete, remove test specimens and test assemblies; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Owner 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.

M. 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. Obtain Owners approval of all aspects of the mock-up before beginning construction, including location and orientation.
2. Build mockups of size large enough to show all related materials and details.
3. Build mockups in location and orientation indicated or, if not indicated, as directed by Owner.
4. Assemble and erect specified items, with specified attachment and anchorage devices, flashing, seals, and finishes.
5. Notify Owner **7** days in advance of dates and times when mockups will be constructed.
6. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
7. Demonstrate the proposed range of aesthetic effects and workmanship.
8. Obtain Owner's approval of mockups before starting corresponding work, fabrication, or construction.
    a. Allow 7 days for initial review and each re-review of each mockup.
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.

N. Room or Interior Mockups: Where required, construct room or interior mockups according to approved Shop Drawings incorporating required materials and assemblies, finished according to requirements. Provide required lighting and additional lighting where required to enable Owner to evaluate quality of the Work. Comply with requirements in "Mockups" Paragraph.

O. FIELD SAMPLES

1. Install field samples at the site as required by individual specifications section for review.
2. Accepted samples shall represent a quality for the work.
3. Where field sample is specified in individual specification sections to be removed, clear area after field sample has been accepted by Owner.

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 testing agency to perform quality-control services.
3. Notify testing agencies at least 48 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are required, 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 Owner, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Owner, 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. Associated Contractor 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 as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, 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: Conducted by a qualified special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections and in the Statement of Special Inspections attached to this Section, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Owner, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Owner and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.

PART 2 PROCUCTS

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 Owner.
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 Owner's, Commissioning Authority's, reference during normal working hours.

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

3.2 DEFICIENT WORK

A. General: If any materials or equipment (whether by testing or observation by the Owner) fails to meet the requirements of the Contract Documents, such materials or equipment shall be subject to removal and replacement by the Contractor. These non-conforming materials shall be removed from the site and replaced with material or equipment meeting the requirements of the Contract Documents at no cost to the Owner. At the discretion of the Owner, the installed defective materials and equipment may be permitted to remain in place subject to a proper adjustment of the Contract Sum.

B. If tests or inspections reveal failure of materials to comply with the requirements of the Contract Documents, the costs of additional testing, and compensation for the Architects/Engineer’s additional services, made necessary by such failure, shall be charged to the Contractor by Change Oder.

3.3 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 Section 017300 "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

SECTION 014200 - REFERENCES

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 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Owner's action on Contractor's submittals, applications, and requests, "approved" is limited to Owner's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Owner. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; (Formerly: ACI International); www.abma.com.
9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
11. AF&PA - American Forest & Paper Association; www.afandpa.org.
12. AGA - American Gas Association; www.aga.org.
13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
15. AI - Asphalt Institute; www.asphaltinstitute.org.
16. AIA - American Institute of Architects (The); www.aia.org.
17. AISC - American Institute of Steel Construction; www.aisc.org.
18. AISI - American Iron and Steel Institute; www.steel.org.
19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.
25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.

33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWPA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CEA - Canadian Electricity Association; www.electricity.ca.
51. CEA - Consumer Electronics Association; www.ce.org.
52. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
53. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
54. CGA - Compressed Gas Association; www.cganet.com.
55. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
56. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
57. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
58. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
59. CPA - Composite Panel Association; www.pbmdf.com.
60. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
61. CRRC - Cool Roof Rating Council; www.coolroofs.org.
62. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
63. CSA - Canadian Standards Association; www.csa.ca.
64. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
65. CSI - Construction Specifications Institute (The); www.csinet.org.
66. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
67. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
68. CWC - Composite Wood Council; (See CPA).
69. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
70. DHI - Door and Hardware Institute; www.dhi.org.
71. ECA - Electronic Components Association; (See ECIA).
72. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
73. ECIA - Electronic Components Industry Association; www.eciaonline.org.
74. EIA - Electronic Industries Alliance; (See TIA).
75. EIMA - EIFS Industry Members Association; www.eima.com.
76. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
77. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
78. ESTA - Entertainment Services and Technology Association; (See PLASA).
79. EVO - Efficiency Valuation Organization; www.evo-world.org.
80. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
81. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
82. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.

83. FM Approvals - FM Approvals LLC; www.fmglobal.com.
84. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
85. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridaroof.com.
86. FSA - Fluid Sealing Association; www.fluidsealing.com.
87. FSC - Forest Stewardship Council U.S.; www.fscus.org.
88. GA - Gypsum Association; www.gypsum.org.
89. GANA - Glass Association of North America; www.glasswebsite.com.
90. GS - Green Seal; www.greenseal.org.
91. HI - Hydraulic Institute; www.pumps.org.
92. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
93. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
94. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
95. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
96. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
97. IAS - International Accreditation Service; www.iasonline.org.
98. IAS - International Approval Services; (See CSA).
99. ICBO - International Conference of Building Officials; (See ICC).
100. ICC - International Code Council; www.iccsafe.org.
101. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
102. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
103. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
104. IEC - International Electrotechnical Commission; http://www.iec.ch.
105. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
106. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
107. IESNA - Illuminating Engineering Society of North America; (See IES).
108. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
109. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
110. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
111. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
112. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
113. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
114. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
115. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
116. ISO - International Organization for Standardization; www.iso.org.
117. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
118. ITU - International Telecommunication Union; www.itu.int/home.
119. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
120. LMA - Laminating Materials Association; (See CPA).
121. LPI - Lightning Protection Institute; www.lightning.org.
122. MBMA - Metal Building Manufacturers Association; www.mbma.com.
123. MCA - Metal Construction Association; www.metalconstruction.org.
124. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
125. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
126. MHIA - Material Handling Industry of America; www.mhia.org.
127. MIA - Marble Institute of America; www.marble-institute.com.
128. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
129. MPI - Master Painters Institute; www.paintinfo.com.
130. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
131. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.

132. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
133. NADCA - National Air Duct Cleaners Association; www.nadca.com.
134. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
135. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
136. NBI - New Buildings Institute; www.newbuildings.org.
137. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
138. NCMA - National Concrete Masonry Association; www.ncma.org.
139. NEBB - National Environmental Balancing Bureau; www.nebb.org.
140. NECA - National Electrical Contractors Association; www.necanet.org.
141. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
142. NEMA - National Electrical Manufacturers Association; www.nema.org.
143. NETA - InterNational Electrical Testing Association; www.netaworld.org.
144. NFHS - National Federation of State High School Associations; www.nfhs.org.
145. NFPA - National Fire Protection Association; www.nfpa.org.
146. NFPA - NFPA International; (See NFPA).
147. NFRC - National Fenestration Rating Council; www.nfrc.org.
148. NHLA - National Hardwood Lumber Association; www.nhla.com.
149. NLGA - National Lumber Grades Authority; www.nlga.org.
150. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
151. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
152. NRCA - National Roofing Contractors Association; www.nrca.net.
153. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
154. NSF - NSF International; www.nsf.org.
155. NSPE - National Society of Professional Engineers; www.nspe.org.
156. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
157. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
158. NWFA - National Wood Flooring Association; www.nwfa.org.
159. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
160. PDI - Plumbing & Drainage Institute; www.pdionline.org.
161. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
162. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
163. RFCI - Resilient Floor Covering Institute; www.rfci.com.
164. RIS - Redwood Inspection Service; www.redwoodinspection.com.
165. SAE - SAE International; www.sae.org.
166. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
167. SDI - Steel Deck Institute; www.sdi.org.
168. SDI - Steel Door Institute; www.steeldoor.org.
169. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
170. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
171. SIA - Security Industry Association; www.siaonline.org.
172. SJI - Steel Joist Institute; www.steeljoist.org.
173. SMA - Screen Manufacturers Association; www.smainfo.org.
174. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
175. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
176. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
177. SPIB - Southern Pine Inspection Bureau; www.spib.org.
178. SPRI - Single Ply Roofing Industry; www.spri.org.
179. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
180. SSINA - Specialty Steel Industry of North America; www.ssina.com.
181. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
182. STI - Steel Tank Institute; www.steeltank.com.
183. SWI - Steel Window Institute; www.steelwindows.com.

184. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
185. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
186. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
187. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
188. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
189. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
190. TMS - The Masonry Society; www.masonrysociety.org.
191. TPI - Truss Plate Institute; www.tpinst.org.
192. TPI - Turfgrass Producers International; www.turfgrasssod.org.
193. TRI - Tile Roofing Institute; www.tileroofing.org.
194. UL - Underwriters Laboratories Inc.; www.ul.com.
195. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
196. USAV - USA Volleyball; www.usavolleyball.org.
197. USGBC - U.S. Green Building Council; www.usgbc.org.
198. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
199. WASTEC - Waste Equipment Technology Association; www.wastec.org.
200. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
201. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
202. WDMA - Window & Door Manufacturers Association; www.wdma.com.
203. WI - Woodwork Institute; www.wicnet.org.
204. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
205. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov/fdsys.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.

14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.

    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.

6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
3. CDHS; California Department of Health Services; (See CDPH).
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservice.tamu.edu.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 – 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.

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

A. General: Installation and removal of 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, Owner's construction forces**,** Architect, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 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. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

D. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Services: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide and maintain for the duration of construction a temporary fence of design and type needed to prevent entry onto the Work site by unauthorized persons.

1. The Contractor shall prepare and submit a proposed plan of the layout of the temporary fence to the Owner for approval prior to installation.
2. The contractor’s fencing plan will be coordinated by the contractor not to impede the use and service of the existing occupied facility.

2.2 TEMPORARY FACILITIES

A. General: Maintain all temporary facilities and controls necessary for the performance of the Work. Comply with all applicable codes and regulations of authorities having jurisdiction. Locate and install all facilities and controls where acceptable to the local authorities having jurisdiction, utility, and Owner and remove same and terminate, in a manner suitable to the utility and Owner at the completion of the Work or when otherwise directed. Pay all costs associated with the provision and maintenance of temporary facilities and controls including power, water, and fuel (if any) consumed until Substantial Completion.

B. Field Offices, General: At the contractor’s option, they may install prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading. Location, access, installation/removal schedule, and other specifics are to be fully coordinated with the Owner. Restore site to original/final condition upon completion of project.

C. Common-Use Field Office: Not required. The Owner may elect to use space in the existing structures for office space, however no existing spaces will be made available to the contractor for office use.

D. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

E. Storage and Staging Areas: The Contractor shall be responsible for coordination, protection and safekeeping of products stored on site under this Contract including soil cut and fill.

1. Move stored products that interfere with construction of the Work, or operations of the Owner or separate contractors.
2. Obtain and pay for use of additional storage or staging areas as needed for the Work.
3. Provide storage areas sized to storage requirements for products of individual Sections, allowing for access and orderly maintenance and inspection of products.

2.3 SANITARY FACILITIES

A. Temporary Toilets

1. The Contractor shall provide and maintain an adequate number of approved prefabricated temporary toilets with proper enclosures as necessary for use of both men and women working on site. Keep toilets clean and comply with all applicable health and safety regulations.

2.4 ENCLOSURES

A. Provide and maintain for the duration of construction all scaffolds, tarpaulins, canopies, warning signs, steps, platforms, bridges, and other temporary construction necessary for proper completion of the Work in compliance with pertinent safety and other regulations.

2.5 TEMPORARY FENCING

A. Provide and maintain for the duration of construction a temporary fence of design and type needed to prevent entry onto the Work site by unauthorized persons.

1. The Contractor shall prepare and submit a proposed plan of the layout of the temporary fence to the Owner and Architect for approval prior to installation.

2.6 TEMPORARY SIGNS

A. Except as otherwise specifically approved by the Owner, do not permit signs or advertising on the job site.

2.7 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. 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 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, clean HVAC system as required in Section 017700 "Closeout Procedures."
   a. Replace filters during construction as necessary to protect equipment and indoor air quality.

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.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

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 UTILITIES

A. Utility Maintenance
1. The Contractor shall maintain all building utility services at all times that the building is occupied. Outages shall be limited and should only occur when the building is not occupied.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Temporary water (Renovation and/or additions where facility is vacated): The Contractor shall make the necessary arrangements to provide all water required during the entire construction period. At the Owner’s discretion, the Contractor may use the existing service and meter.

D. Sanitary Facilities: Provide temporary toilets, wash 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.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting 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.

1. 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.

2. After the building or portion thereof is completely enclosed by either permanent construction or substantial temporary materials, and before installation of finishes, Contractor shall pay for and provide heat therein of not less than 55 degrees F., or more than 75 degrees F., which shall be continuously maintained in the enclosed area until the project is accepted.

3. The installation and operation of heating devices shall comply with all safety regulations including provisions for adequate ventilation and fire protection. Heating devices, which may cause damage to finish surfaces, shall not be used.

4. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated, and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

F. Use of Permanent Heating Equipment

1. The Contractor shall be responsible for the use of the permanent heating and cooling system for the purposes described and shall pay all costs in connection therewith.

G. Temporary Ventilation: Provide adequate ventilation in enclosed areas throughout construction period required to: facilitate progress of Work; to protect Work and products against excessive dampness and heat; to prevent moisture condensation on surfaces; to provide suitable environmental conditions for installation and curing of finish materials; to provide adequate ventilating to meet health regulations for safe working environment; and, to prevent hazardous accumulations of dusts, fumes, mists, vapors or gases in areas occupied during construction. Provide local exhaust ventilating to prevent harmful dispersal of hazardous substances into atmosphere of occupied areas. Dispose of exhaust materials in manner that will not result in harmful exposure to persons or property. Provide ventilating operations at all times personnel occupy an area subject to hazardous accumulations of harmful elements. Continue operation of ventilating system for as long as required after cessation of construction activities to assure removal of harmful elements.

D. Electric Power Service: The Contractor shall make the necessary arrangements and provide all temporary electric service and lighting required during the entire construction period.

H. Lighting: 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 entire system.

I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Provide telephone service near first aid station.

1. At each telephone, post a list of important telephone numbers.

a. Police and fire departments.
b. Ambulance service.
c. Contractor's home office.
d. Contractor's emergency after-hours telephone number.
e. Engineers' offices.
f. Owner's office.
g. Principal subcontractors' field and home offices.

3.4 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Owner schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas [as indicated] and within construction limits indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 312000 "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Section 321216 "Asphalt Paving."

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Maintain traffic on all streets adjacent to or leading to the site. Where construction operations interfere with the free movement of traffic, provide approved traffic controls, flagmen or similar devices to efficiently control traffic movement. With prior approval, provide detours as necessary for unimpeded traffic flow.
2. Protect existing site improvements to remain including curbs, pavement, and utilities. Keep streets, drives, and walks adjacent to site and haul routes clean and free of dirt, debris, and litter caused by construction operations.

3. Provide means of removing mud and debris from vehicle wheels before entering public streets. Clean mud and debris from public streets and sidewalks as required.
4. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Maintenance of Access: Contractor shall provide and maintain until Substantial Completion, means of safe access to, around and within the site, for vehicular and personnel traffic.

F. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

G. Project Signs: Unauthorized signs are not permitted.

H.

1. Temporary Signs: Provide signs as required to inform public and individuals seeking entrance to Project.

    a. Provide temporary, directional signs for construction personnel and visitors.

2. Maintain and/or touch up signs so they are legible at all times.

I. Design of Temporary Structures: The structural design of all items used in the construction of the building and not a permanent part thereof, including but not necessarily limited to hoisting towers, scaffolding, shoring for concrete and masonry work, the temporary bracing for structural steel, and the shoring of cut earth banks, is the sole responsibility of the Contractor.

J. The structural design is based on the interaction of all the parts of the completed building. The contractor shall solely bear the risk for providing adequate stability and safety of the structure during construction.

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. Comply with work restrictions specified in Section 011000 "Summary."

C. Temporary Erosion and Sedimentation Control: Comply with the requirements of authorities having jurisdiction and the civil drawings.

D. 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.

E. 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.

F. 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.

G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site.

H. 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.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. 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 heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

K. Temporary Fire Protection: Where needed 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 according to 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. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage. Avoid trapping water in finished Work. Document visible signs of mold that may appear during construction.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

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. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700

END OF SECTION 015000

SECTION 016000 – 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. "Substitution Procedures" for requests for substitutions.
2. "References" for applicable industry standards for products specified.
3. "Closeout Procedures" for coordinating closeout of the Contract.

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. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process 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 specific manufacturer's product is named and accompanied by the words "basis-of-design product," 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 additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source. When specified products are available only from sources that do not, or cannot, produce a quantity adequate to complete project requirements in a timely manner, consult with the Architect/Engineer and Owner to determine the most important product qualities before proceeding. Qualities may include attributes, such as visual appearance, strength, durability, or compatibility. After a determination has been made, provide products from sources producing products that possess these qualities, to the fullest extent possible.

B. 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.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

C. Whenever the Contract Documents require that a product complies with Federal Specifications, ASTM Designations, ANSI Specifications or other association standard, the Contractor shall present an affidavit from the manufacturer certifying that the product complies therewith. Where requested or specified, submit supporting test data to substantiate compliance.

D. Nameplates and labels: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.

E. Workmanship:

1. Comply with industry standards, except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
2. Perform work by persons qualified to produce workmanship of specified quality.
3. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

F. Manufacturer's Instructions:

1. When work is specified to comply with manufacturer's instructions, submit copies as specified in Division 01 Section SUBMITTAL PROCEDURES, distribute copies to persons involved, and maintain one set in field office.
2. Perform work in accordance with details of instructions and specified requirements.

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 upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Provide appropriate equipment and qualified personnel to move products on-site without damage.
6. Each product shall be marked with unique identifiers including the project name, specifications reference and any other information needed to identify the product's specific use on the Project.

C. Storage:

1. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
2. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.
3. Store products subject to damage above ground, under cover in a ventilated weather tight enclosure. Maintain temperature and humidity within range required by manufacturer's instructions.
4. Prevent product contact with materials that may cause corrosion, discoloration or staining.
5. Store materials in a manner that will not endanger Project or temporary structures.
6. Provide off-site storage when site does not permit adequate on-site storage or protection.
7. Store cementitious products and materials on elevated platforms.

8. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
9. Protect stored products from damage and liquids from freezing.
10. For exterior storage of fabricated products, place on sloped supports above ground.
11. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.
12. Arrange storage to provide access for inspection.
13. Concentrations of combustibles and flammable materials within, on, or near the structure should be kept to a minimum.
13. Extra care should be taken to relocate or cover combustible materials during hot work operations. The FM Global Hot Work Permit System should be used for cutting, welding, brazing, soldering, etc..
14. Adequate emergency procedures and temporary fire protection should be available during construction. This would include appropriate fire extinguishers and a self-performed watch service to flag out potential hazards.

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 warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for 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 with the Specifications, 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 Section 017700 "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 not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Owner 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 "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
7. **St. Mary's County Public Schools will not accept any products that contain any asbestos containing materials, lead paint or mercury. Contractor to provide notarized statement that none of these materials was used anywhere on the project to the Owner at Final Completion.**

B. Product Selection Procedures:

1. Proprietary Specification Requirements: Where only a single product or manufacturer is named, provide the product indicated. No substitutions will be permitted after bidding.
2. Semiproprietary Specification Requirements: Where two or more products or manufacturers are named, provide one of the products indicated. No substitutions will be permitted after bidding.

    a. Where products or manufacturers are named, accompanied by the term "or approved equivalent", or "approved equal", comply with the Contract Document provisions for "substitutions" to obtain approval for use of an unnamed product. These terms are not implied and can only be used where specifically specified.

3. 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 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.
4. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.
5. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements, and are recommended by the manufacturer for the application indicated.

    a. Manufacturer's recommendations may be in published product data, or by the manufacturer's certification of performance.

6. Compliance with Standards, Codes and Regulations: Where the Specifications only require compliance with an imposed code, standard or regulation, select a product that complies with applicable standards, codes or regulations.
7. Visual Matching: Where Specifications require matching an established Sample, the Owner's decision will be final on whether a proposed product matches satisfactorily.

    a. Where no product in the specified category matches and also complies with specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category, or for noncompliance with specified requirements.

8. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Owner will select the color, pattern and texture from the product line selected.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Any proposed Comparable Product Request must maintain the quality standards established by the Contract Documents for the specified product without any detrimental effect to the Owner. Refer to General Conditions of Contract for additional requirements.

B. Owner will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Owner may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require 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 those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, 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 owners, if requested.
5. Samples, if requested.

C. Submittal Requirements: Approval by the Owner of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

2.3 MARYLAND BUY AMERICAN STEEL ACT

A. **All steel purchased for this project is to comply with the Buy American Steel Act: Sections 17-301 to 17-306 of the Finance and Procurement Article of the Annotated Code of Maryland.**

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

A. Comply with manufacturer's instructions and recommendations for installation of products. Anchor each product securely in place, accurately located and aligned with other Work.
1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
2. Comply with additional Drawing and Specification requirements.

B. Products shall be applied, installed, connected, erected, used, adjusted, cleaned and conditioned in accordance with the respective manufacturer’s instructions and recommendations unless more stringent requirements are specified.

C. Verify and coordinate clearances, dimensions and installation of adjoining construction, equipment, piping, ducts, conduits, or other mechanical or electrical items or apparatus.

D. Prior to fabrication, field measure actual existing conditions as applicable to ensure proper fit.

E. Inspect each item of material or equipment immediately prior to installation. Reject damaged and defective items.

F. Recheck measurements and dimensions of Work, as an integral step of starting each installation. Whenever stock manufactured products are specified, verify actual space requirements for setting or placing into allotted space.

G. Anchor each product securely in place with positive anchorage devices designed and sized to withstand expected loads. Anchors shall be accurately located and aligned with other Work.

H. Allow for expansion of materials and building movement.

3.2 PROTECTION OF INSTALLED WORK

A. Clean, protect, adjust and perform maintenance on installed Work as necessary to ensure freedom from damage and deterioration at time of Substantial Completion. Remove protective devices when no longer needed.

B. Provide special protection where specified in individual Specification Sections.

C. Provide temporary and removable materials for protection of installed products. Control activity in immediate work area to minimize damage.

D. Protect finished Work from damage, defacements, stains, scratches, and wear.

E. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

F. Protect finished floors, stairs, and other surfaces from traffic dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

G. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

H. Prohibit traffic from lawn and landscaped areas.

3.3 QUALITY STANDARDS

A. Workmanship specified or indicated on the Drawings by reference to title, symbol, or number of a Commercial or Industry Standard, ASTM designation, ANSI designation, Manufacturer's data, or other similar reference standard is identified hereby as the minimum requirement for the quality of workmanship required hereunder. References are to the current issues of same, except as indicated otherwise. If not in contradiction to the building code or regulations of other governmental agencies as may have jurisdiction, such referenced documents shall be considered as an integral part of these specifications as if repeated word for word herein.

B. Owner may require that copies of certain reference specifications be kept at the job site.

C. Damaged products shall be not installed as part of the Work. At the Owner’s sole discretion, the Owner may approve the use of repaired items in the Work. The Contractor shall bear all costs related to replacing or repairing and refurbishing damaged products.

3.4 WORKMANSHIP

A. Note that the quality required for certain workmanship specified in respective Specification sections may be better than that established by the identified reference standards.

B. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

C. Perform work by persons qualified to produce workmanship of specified quality.

3.5 MANUFACTURERS' INSTRUCTIONS

A. When work is specified to comply with manufacturers' instructions, submit copies as specified in 013300, distribute copies to persons involved, and maintain one set in field office.

END OF SECTION 016000

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-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedure" for submitting surveys.
3. Section 017700 "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.

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 or professional engineer.

B. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.

C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Utilities: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

    a. Include description of provisions if required for temporary services and systems during interruption of permanent services and systems.

D. Landfill Receipts as required: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

E. Certified Surveys: Submit two copies signed by a land surveyor or professional engineer.

F. Final Property Survey: Submit 2 copies showing the Work performed and record survey data.

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. 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, notify Engineer of Record of locations and details of cutting and await directions from Engineer 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. 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. Masonry walls
    b. Concrete slab

3. Visual Elements: Do not cut and patch existing construction to remain 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 Owner's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, 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 Owner for the visual and functional performance of in-place materials.

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 and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, 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 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.
4. Inspect existing conditions, including elements subject to movement or damage during cutting, excavating, patching and backfilling. After uncovering the Work, inspect conditions affecting installation of new Work.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections or if uncovered conditions are not as anticipated, immediately notify the Owner and include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. 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 caused by differing field conditions outside the control of Contractor, submit a request for information to Owner according to requirements in Section 013100 "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. If discrepancies are discovered, notify Owner promptly.

B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each level 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 Owner 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 Owner.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. 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 Owner. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Owner before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. 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.

D. 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.

E. Slab and Wall Check Survey:

1. After the first sections of slab-on-grade have been placed in the building, the Contractor shall have a professional engineer or land surveyor verify and record the finish floor elevations on the wall check survey.
2. After the first sections of slab-on-grade have been placed in the building, the Contractor shall have a professional engineer or land surveyor verify and record the finish floor elevations on the wall check survey.

F. Final Property Survey: Engage a land surveyor or professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."
3. As-Built survey shall be included in a standard C.A.D. format such as AutoCAD and/or BIM Revit and shall include 2-foot contours within the project limits.

G. The contractor will be responsible for scheduling the Owner’s 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 Charles County’s Standard Stormwater Management checklist. The Contractor’s shall have a professional land surveyor prepare and certify as-built survey, and the testing and inspection agent shall have thier 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 two (2) copies final stormwater management facility as-built, testing and inspection checklist(s) and additional facility information in accordance with the requirements set forth by Charles County.

3.5 INSTALLATION

A. General: 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 84 inches in occupied spaces or higher as indicated in the 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 the best possible results. 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.

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: Where possible, 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.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Owner.
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. Fit exposed connections together to form hairline joints.

J. Conduit: At new wall construction, electrical and low-voltage conduit and similar items are to be concealed inside masonry cores or between studs of new walls. Refer also to electrical drawings and specifications.

K. Repair or remove and replace damaged, defective, or nonconforming Work.

1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, 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. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."

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. 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 minimize 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. Existing masonry walls to receive new work (concealed) related to all disciplines, shall be removed and replaced as required to properly receive new work. New masonry shall be toothed-in with whole units to match adjacent block pattern, size and material.

    a. Damaged or defaced masonry units, existing or resulting from demolition shall be removed and replaced as required to restore adjacent original appearance at walls to remain.

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 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

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. General: 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.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

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 in Finished Areas: 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 Section 017419 "Construction 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 Section 019113 "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. Comply with manufacturer's written instructions for temperature and relative humidity.

END SECTION 017300

SECTION 01 74 00 - WARRANTIES AND BONDS

PART 1 GENERAL

1.1. DESCRIPTION

A. Work included: Compile specified warranties, bonds, and maintenance contracts and submit to the Owner. Warranties to commence no earlier than the date of Substantial Completion. Bond will be submitted in accordance with Division 00.

B. Related Documents

1. Documents affecting work of this Section include, but not necessarily limited to, General Conditions, Supplementary Conditions, other Sections of Division 1 and detailed requirements documented in each respective section of Divisions 2 through 33 of these Specifications.
2. Certifications and other commitments and other agreements for continuing services to the Owner as specified elsewhere in the Contract Documents.

C. Definitions

1. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
2. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.2. DESCRIPTION OF REQUIREMENTS

A. In addition to standard and special warranties described in Specific Sections, the Contractor shall warrant all work included in this project, for a minimum period of one (1) year unless otherwise noted by Addendum and upon acceptance by Owner; following acceptance of a Certificate of Substantial Completion by the Owner, to cover performance, materials, workmanship and compliance with Contract Documents.

B. Manufacturer's disclaimers and limitations on product warranties **do not** relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

C. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

D. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

E. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

F. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on

time in which the Owner can enforce such other duties, obligations, rights, or remedies.

G. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

H. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

1.3. QUALITY ASSURANCE

A. Use adequate care and diligence to thoroughly review all Contract Documents to identify detailed requirements relating to warranties and bonds.

B. Verify that each item required for this submittal conforms in all respects with the specified requirements.

1.4. SUBMITTALS

A. Assemble warranties bonds and service and maintenance contracts, executed by each respective manufacturer, supplier and contractor.

B. Submit written warranties to the Owner prior to the date established for Substantial Completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion, or a designated portion of the Work, submit written warranties upon request of the Owner.

C. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Owner within fifteen days of completion of that designated portion of the Work.

D. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner for approval prior to final execution.

E. Form of Submittals

1. At Final Completion, compile two copies of each required warranty and bond properly executed by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
2. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper.
3. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer.
4. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS," the Project title or name, and the name of the Contractor.
5. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 PRODUCTS

2.1 SCHEDULE OF WARRANTIES

A. Schedule: Provide warranties and bonds on products and installations as per individual section.

PART 3 EXECUTION

Not Used

END OF SECTION 017400

SECTION 01 77 00 - CLOSEOUT PROCDURES

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. Demonstration and Training.
5. Final cleaning.
6. Repair of the Work.

B. Related Requirements:

1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.3 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.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 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 as indicated in Paragraph D below.
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. Demonstration and Training

1. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
2. 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. At the Owner's option, record each session with a digital video recording and submit to Owner on a thumb drive or format of the Owner's choice.
3. Training Modules:
    a. Basis of System Design, Operational Requirements, and Criteria: Include the following:
        1) System, subsystem, and equipment descriptions.
        2) Performance and design criteria if Contractor is delegated design responsibility.
        3) Operating standards.
        4) Regulatory requirements.
        5) Equipment function.
        6) Operating characteristics.
        7) Limiting conditions.
        8) Performance curves
    b. Documentation: Review the following items in detail:
        1) Emergency manuals.
        2) Systems and equipment operation manuals.
        3) Systems and equipment maintenance manuals.
        4) Product maintenance manuals.
        5) Project Record Documents.
        6) Identification systems.
        7) Warranties and bonds.
        8) Maintenance service agreements and similar continuing commitments.
    c. Operations: 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) Control sequences.
        6) Safety procedures.
        7) Instructions on stopping.
        8) Normal shutdown instructions.
        9) Operating procedures for emergencies.
        10) Operating procedures for system, subsystem, or equipment failure.
        11) Seasonal and weekend operating instructions.
        12) Required sequences for electric or electronic systems.
        13) Special operating instructions and procedures.
    d. Adjustments: Include the following:
        1) Alignments.
        2) Checking adjustments.
        3) Noise and vibration adjustments.
        4) Economy and efficiency adjustments.
    e. Troubleshooting: Include the following:

1) Diagnostic instructions.
2) Test and inspection procedures.

f. Maintenance: Include 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) Procedures for routine cleaning.
5) Procedures for preventive maintenance.
6) Procedures for routine maintenance.
7) Instruction on use of special tools.

g. Repairs: Include the following:

1) Diagnosis instructions.
2) Repair instructions.
3) Disassembly; component removal, repair, and replacement; and reassembly instructions.
4) Instructions for identifying parts and components.
5) Review of spare parts needed for operation and maintenance

E. 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, Owner will either proceed with inspection or notify Contractor of unfulfilled requirements. Owner 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 Owner, that must be completed or corrected before certificate will be issued.

1. Request reinsertion 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.

1.7 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 as indicated in the General Conditions of the Contract.
2. Certified List of Incomplete Items: Submit certified copy of Owner's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Owner. 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 a notarized and signed letter to the Owner indicating that no asbestos containing materials, lead paint or mercury were used in the construction of the project.

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, Owner will either proceed with inspection or notify Contractor of unfulfilled requirements. Owner 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.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. General Contractor is to compile a List of incomplete items and provide to Owner prior to Owner inspecting Work and adding as needed to Punch List.

B. 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.
2. Organize items applying to each space by major element, including categories for ceiling, 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 Contractor.
    d. Page number.

4. Submit list of incomplete items to Owner in one of the following formats:

    a. MS Excel electronic file. Owner, will return annotated file.
    b. PDF electronic file. Owner, will return annotated file.
    c. Web-based project software upload. Utilize software feature for creating and updating list of incomplete items (punch list).

C. Upon notification that all items on the punch list are completed, Owner will re-inspect punch list items and review for acceptance. Any items still not addressed or not acceptable will be noted and the Owner will inform Contractor of final outstanding items. Additional requests to re-inspect outstanding items (or new ones) will be at the Contractor’s expense for the Owner additional site visits, travel, time spent to re-inspect and all related expenses in issuing and tracking outstanding items. This additional service will be approved in writing by the Contractor prior to Owner performing this work.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Owner 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. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

C. 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.

D. Warranties in Paper Form:

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

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, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, 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. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
j. 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.
k. Remove labels that are not permanent.
l. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

    1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.

p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
q. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

    a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017823 – 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.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

B. Related Requirements:
1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Owner and, if applicable, Commissioning Authority will comment on whether content of operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Owner.

a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
b. Enable inserted reviewer comments on draft submittals.

2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves.

C. Initial Manual Submittal: Submit draft copy of each manual at least 15 days before commencing demonstration and training. Owner 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.

1.5 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. 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.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

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."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: 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 Authority.
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. 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 (215-by-280-mm)

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, and indicate Specification Section number on bottom of spine. 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.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) 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.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. 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.

C. 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.

D. 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.

2.4 OPERATION MANUALS

A. 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.

B. 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.

C. 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.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

A. 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.

B. Source Information: List each product, 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.

C. 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.

D. 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.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. 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.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. 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 warranty and bond information, as described below.

B. 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.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
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.

D. 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.

E. 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.

F. 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.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. 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 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. 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.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

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.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, 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.

1. 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.

F. 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 operation and maintenance manuals.

Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

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 by Contractor for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 017300 "Execution" for final property survey.
2. Section 017700 "Closeout Procedures" for general closeout procedures.
3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Comply with pertinent provisions of Section 013300.

B. Prior to submitting request for final payment, submit the final Project Record Documents to the Owner and secure his approval.

C. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set of marked-up record prints.
2. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal:

1) Submit PDF electronic files of scanned record prints and one set of prints.
2) Owner will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit PDF electronic files of scanned record prints.
2) Plot each drawing file, whether or not changes and additional information where recorded.

D. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

E. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

F. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

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 Owner'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 sets 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. 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. Identification: As follows:

a. Project name.
b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Architect and Owner.
e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as scanned PDF electronic file of marked-up paper copy of Specifications.

1.6 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

C. Format: Submit record Product Data as annotated PDF electronic file or scanned PDF electronic files of marked-up paper copy of Product Data.

1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.7 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 file or 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.

1.8 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 Owner's reference during normal working hours.

1.9 QUALITY ASSURANCE

A. Delegate the responsibility for maintenance of Record Documents to one person on the Contractor's staff as approved by the Architect.

B. Accuracy of records
1. Thoroughly coordinate changes within the Record Documents, making adequate and proper entries on each page of Specifications and each sheet of Drawings and other Documents where such entry is required to show the change properly.
2. Other requirements affecting Project Record Documents may appear in other pertinent Sections of these Specifications.
3. Conversion of schematic layouts
    a. In some cases on the Drawings, arrangements of conduits, circuits, piping, ducts, and similar items, is shown schematically and is not intended to portray precise physical layout. However, design of future modifications of the facility may require accurate information as to the final physical layout of items which are shown only schematically on the Drawings.
    b. Show on the job set of Record Drawings, by dimension accurate to within one inch, the centerline of each run of items such as are described in subparagraph above. Final physical arrangement is determined by the Contractor, subject to the Architect's approval.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017839

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1. DESCRIPTION

A. Related Documents:

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

B. Summary:

1. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

a. Footings.

b. Slabs-on-grade.

c. Housekeeping pads.

C. Related Sections:

1. Division 32 Section “Concrete for Sitework”

D. Definitions:

1. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, ground granulated blast-furnace slag; subject to compliance with requirements.

1.2. SUBMITTALS

A. Combine all requested information in this section together as one submittal.

1.3. ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

E. Samples: For waterstops, vapor retarder.

1.4. INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Waterstops.
5. Curing compounds.
6. Floor and slab treatments.
7. Bonding agents.
8. Adhesives.
9. Vapor retarders.

B. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

C. Minutes of preinstallation conference.

1.5. QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 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.
2. Personnel performing laboratory tests shall be 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.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5."
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

G. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.

1. Build panel approximately 100 sq. ft. for slab-on-grade in the location indicated by, and if required by, the Owner.

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

H. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.

b. Independent testing agency responsible for concrete design mixtures.

c. Concrete subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.6. DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1. FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2. STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3. REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

2.4. CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I Type III gray. May be supplemented with the following:

a. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

2. Blended Hydraulic Cement: ASTM C 595, Type IS, portland blast-furnace slag.

B. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

2.5. ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: 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. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.

6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6. WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured trapezoidal strip, butyl rubber with sodium bentonite, for adhesive bonding to concrete in acceptance with section 032500.

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. Carlisle Coatings & Waterproofing, Inc.; MiraSTOP.

b. CETCO; Volclay Waterstop-RX.

c. Concrete Sealants Inc.; Conseal CS-231.

d. Greenstreak; Swellstop.

e. Henry Company, Sealants Division; Hydro-Flex.

f. JP Specialties, Inc.; Earth Shield Type 20.

g. Approved Substitute.

2.7. VAPOR RETARDERS

A. 15-Mil Reinforced Vapor Retarder in compliance with ASTM E 1745, Class A.

1. Maximum Permeance ASTM E 96: 0.010 perms (English).

2. Provide standard accessories and tape for complete system.

B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.8. CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

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. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.

b. BASF Construction Chemicals - Building Systems; Kure 200.

c. ChemMasters; Safe-Cure Clear.

d. Conspec by Dayton Superior; W.B. Resin Cure.

e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).

f. Edoco by Dayton Superior; Res X Cure WB.

g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.

h. Kaufman Products, Inc.; Thinfilm 420.

i. Lambert Corporation; AQUA KURE - CLEAR.

j. L&M Construction Chemicals, Inc.; L&M Cure R.

k. Meadows, W. R., Inc.; 1100-CLEAR.

l. Nox-Crete Products Group; Resin Cure E.

m. Right Pointe; Clear Water Resin.

n. SpecChem, LLC; Spec Rez Clear.

o. Symons by Dayton Superior; Resi-Chem Clear.

p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.

q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

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. Anti-Hydro International, Inc.; AH Clear Cure WB.

b. BASF Construction Chemicals - Building Systems; Kure-N-Seal WB.

c. ChemMasters; Safe-Cure & Seal 20.

d. Conspec by Dayton Superior; Cure and Seal WB.

e. Cresset Chemical Company; Crete-Trete 309-VOC Cure & Seal.

f. Dayton Superior Corporation; Safe Cure and Seal (J-18).

g. Edoco by Dayton Superior; Spartan Cote WB II.

h. Euclid Chemical Company (The), an RPM company; Aqua Cure VOX; Clearseal WB 150.

i. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.

j. Lambert Corporation; Glazecote Sealer-20.

k. L&M Construction Chemicals, Inc.; Dress & Seal WB.

l. Meadows, W. R., Inc.; Vocomp-20.

m. Metalcrete Industries; Metcure.

n. Nox-Crete Products Group; Cure & Seal 150E.

o. Symons by Dayton Superior; Cure & Seal 18 Percent E.

p. TK Products, Division of Sierra Corporation; TK-2519 WB.

q. Vexcon Chemicals, Inc.; Starseal 309.

2.9. RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

C. Exterior Drainage Board: Where indicated in the drawings, provide MEL-DRAIN 5012 or approved equal drainage board on exterior side of concrete foundation wall. Install per manufacturer's written instructions and recommendations.

2.10. REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.11. CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301. See structural plans for required concrete strengths.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Ground Granulated Blast-Furnace Slag: 35 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing or plasticizing 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.

3. Use water-reducing admixture in pumped concrete, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.12. FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13. CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer. Project site mixing may only be used for topping slabs and housekeeping pads.

1. For mixer capacity of 1 cu. yd. 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 mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..

3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1. FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.

2. Class B, 1/4 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.

2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2. EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3. Install dovetail anchor slots in concrete structures as indicated.

3.3. REMOVING AND REUSING FORMS

A. General: Formwork for sides of walls, piers and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Owner.

3.4. VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.5. STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6. JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

1. All joints will be coordinated with terrazzo joint pattern when applicable. Additional joint quantity or complexity to accommodate terrazzo pattern is included at no additional cost to the owner.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Owner.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.

2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3. Column Isolation Joints under terrazzo finish wall be held tight to the column in order to avoid encroachment under the terrazzo.

3.7. WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.8. CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by the Owner.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Maintain reinforcement in position on chairs during concrete placement.

3. Screed slab surfaces with a straightedge and strike off to correct elevations.

4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 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 average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water 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 cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9. FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10. FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces. Coordinate concrete finish with intended floor finishes.

B. Provide finishes below where indicated.

C. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings, to receive mortar setting beds for bonded cementitious floor finishes.

D. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated to receive trowel finish and sand-bed terrazzo.

E. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. **Ride-on trowels are not permitted on framed slabs.** Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

a. 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.

b. 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; for slabs-on-grade.

1. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

F. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

G. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with General Contractor before application.

H. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.

2. After broadcasting and tamping, apply float finish.

3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

I. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.

2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.

3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.11. MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.12. CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

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 lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

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.

   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

3.13. JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

3.14 LIQUID FLOOR TREATMENT APPLICATION

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than 14 days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15. CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Owner. Remove and replace concrete that cannot be repaired and patched to Owner's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding

color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Owner.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Owner's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Owner's approval.

3.16. FIELD QUALITY CONTROL

A. Testing and Inspecting: Contractor will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel reinforcement placement.
2. Headed 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.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 50 cu. yd. 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 C 143/C 143M; 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 C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; 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 C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M.
   a. For slab on grade and foundation walls, cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days, 28 days and one set of two specimens at 56 days if required.
   a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. 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.
8. Test results shall be reported in writing to Owner, Structural Engineer, 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.
9. 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 Owner. 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 Owner.

10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

END OF SECTION 033000

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1. DESCRIPTION

A. Summary:

1. Section Includes:

a. Concrete masonry units (CMU's).

b. Face brick (Modular)

B. Related Sections:

1. Division 05 for furnishing steel lintels and shelf angles for unit masonry.

C. REFERENCES

1. Brick Institute of America Technical Notes on Brick Construction.

2. National Concrete Masonry Association “Specification for Design and Construction of Load Bearing Concrete Masonry

1.2. PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

1. Clay Masonry Unit Test: For each type of unit required, according to ASTM C 67 for compressive strength.

2. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.

3. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength.

4. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.

5. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

1.3. SUBMITTALS

A. Changes in specification are only upon written approval by owner.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For reinforcing steel. Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement. "Show elevations of reinforced walls”.

D. Samples for Verification: For each type and color of exposed masonry unit, salvaged masonry unit, replacement unit for historic brick matching, and colored mortar.

E. Samples for Record: Provide two physical samples (full bricks) of **each** brick color/type to Architect for record (SEI Architects, 9211 Corporate Blvd, Suite 340, Rockville MD, 20850).

1.4. INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product indicated. For masonry units include data on material properties and 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.
3. Refer to Section 049020 Masonry Repointing for

1.5. QUALITY ASSURANCE

A. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

B. Protection:

1. All masonry units stored on site shall be covered at all times for protection against weather.
2. All masonry units shall be stored on wood pallets.
3. Masonry shall not be stored on grade.

1.6. 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. 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.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1.7. PRECONSTRUCTION MEETING

A. Prior to the start of any masonry construction work, hold meeting to discuss masonry installation, details, and accessories. In particular, locations of metal flashing with and without hemmed drip edges are to be reviewed to ensure that scope is fully understood. Attendees are to include at a minimum: masonry subcontractor, general contractor, owner’s representative, and architect.

PART 2 - PRODUCTS

2.1. MASONRY UNITS, GENERAL

A. 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.

B. 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. Regional Materials: CMUs shall be manufactured within 500 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Shapes: Provide shapes indicated and for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

C. Integral Water Repellent: Provide units made with liquid polymeric, integral water repellent admixture that does not reduce flexural bond strength where 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. ACM Chemistries; RainBloc.

   b. BASF Aktiengesellschaft; Rheopel Plus.

   c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.

   d. Or approved equal.

D. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000psi and f'm=2000psi minimum.

2. Density Classification: Normal weight unless otherwise indicated.

2.3. CONCRETE AND MASONRY LINTELS

A. General: Provide one of the following:

B. Install loose steel lintels as scheduled.

C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 033000 "Cast-in-Place Concrete," and with reinforcing bars indicated as scheduled on the contract documents (non-bearing walls only).

D. Install reinforced unit masonry lintels as scheduled on the contract documents (non bearing walls only) where steel lintels are not scheduled. Shop fabricate lintels using grout fill and reinforcing. Maintain minimum 8" bearing on each side of opening.

E. Allow lintels to reach strength before removing temporary supports.

2.4. BRICK

A. Regional Materials: Brick shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. General: Provide shapes indicated and as follows:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

C. Face Brick: Facing brick complying with ASTM C 216.

1. Basis of Design Products:
   a. Brick Type 1A (“red”): As proposed by Contractor and approved by Owner to match red brick color at the existing Leonardtown High School main building.
   b. Brick Type 1B (“beige”): As proposed by Contractor and approved by Owner to match tan brick color at the existing Leonardtown High School main building (at the front of the building near the school name aluminum lettering).
   c. All brick to be Closure/Economy size (nominal 4”x4”x8”).
2. Grade: SW.
3. Type: FBS.
4. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3350 psi. Consider retaining first subparagraph below; it eliminates the need to wet brick before laying. Before retaining, verify that brick selected complies with requirements. See Evaluations.
5. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
6. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
7. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet.

D. Cleaning: Units shall be thoroughly cleaned with a masonry compound recommended by the manufacturer.

2.5. REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Mill galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: 9 guage Minimum (W1.7)
4. Wire Size for Cross Rods: 9 guage Minimum (W1.7).

5. Wire Size for Veneer Ties: Varies with product application - to be approved by structural engineer.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

D. Masonry Joint Reinforcement for Multiwythe Masonry:

1. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches wide, plus 2 side rods at each wythe of masonry 4 inches wide or less.
2. Tab type, either ladder or truss design, with 1 side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.
3. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.

2.6. TIES AND ANCHORS

A. 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 A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.

1. Wire: Fabricate from 3/16-inch diameter, hot-dip galvanized steel wire.

D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 3/16-inch diameter, hot-dip galvanized steel wire.

E. Partition Top anchors: By Hohmann & Barnard or equal; 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. 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 wood or 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. Contractor's Option: Unless otherwise indicated, provide any of the following types of anchors:
3. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 213.
        b. Heckmann Building Products Inc.; 315-D with 316.
        c. Hohmann & Barnard, Inc.; DW-10.
        d. Wire-Bond; 1004, Type III.
        e. Or approved equal.
    b. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, having slotted holes for inserting wire tie.
    c. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch thick, steel sheet, galvanized after fabrication.
    d. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.187-inch diameter, hot-dip galvanized steel wire.

G. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

2.7. EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and extend 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed. Omit at bottom of south wall (wall with concessions coiling windows).
2. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
3. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.

B. Embedded through wall flashing: Products: As manufactured by Hyload Cloaked Flashing System, Wadsworth OH.

1. High Performance Flashing Membranes:
    a. TotalFlash by Mortar Net
    b. Hyload Surface Adhered (S/A) With Drip Edge (For Sealant compatibility)
2. Hyload Cloaked Flashing System:
    a. Surface Adhered: External / internal corners, level changes, and stop ends.

b. TotalFlash Integrated Flashing System incorporates cavity drainage, termination bar, fasteners, sealant, lap adhesive and stainless steel drip if required in one product.
c. Utility Cloaks: Internal Corner, Internal Sloped Corner.

3. Accessory Materials:
a. Hyload Double-Sided Tape
b. Hyload Mastic

C. Flashing Membranes:

1. Solder and Sealants for Sheet Metal Flashings.

2. Standard Type: Elastomeric and thermal plastic polymers combined with DuPont Elvaloy, reinforced with synthetic fibers and calendared into 40-mil thick sheets, with the following physical properties:

a. Elongation: 175% (ASTM D412)
b. Tensile Strength: 650 psi (ASTM D412)
c. Tear Strength: 280 psi (ASTM D624)
d. Low Temperature Flexibility: -25° F Pass (ASTM D146)
e. Water Absorption: Less than 0.1% (ASTM D471)
f. Color as selected by Architect from manufacturer’s range of black, grey, buff, or white

3. Self Adhered Membrane: Standard type, with rubberized adhesive and silicone release sheet added, and with the following physical properties:

a. Elongation: 225% (ASTM D412)
b. Tensile Strength: 875 psi (ASTM D412)
c. Tear Strength: 270 psi (ASTM D624)
d. Low Temperature Flexibility: -25° F Pass (ASTM D146)
e. Water Absorption: Less than 0.1% (ASTM D471)
f. Color as selected by Architect from manufacturer’s range of black, grey, buff, or white.

4. Self Adhering With Drip: Shall contain integral drip edge to receive wet sealant.

D. Cloaked Flashing System: Standard or customized three dimensional shapes as indicated on the Drawings to form a complete flashing system with preformed corners, end dams, other special shapes, and seaming materials; all produced by flashing sheet manufacturer.

E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.8. MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Use the following unless otherwise indicated:

1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Mortar Net USA, Ltd.; Mortar Net Weep Vents.

b. Or approved equal.

b. Color: Select color to best match color of mortar.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

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. Not all products in list below are available in all configurations described.

b. Advanced Building Products Inc.; Mortar Break.

c. Archovations, Inc.; CavClear Masonry Mat.

d. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.

e. Mortar Net USA, Ltd.; Mortar Net.

f. Or approved equal.

2. Provide one of the following configurations:

a. Strips, full-depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep.

b. Strips, not less than 3/4 inch thick and 10 inches high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.

c. Sheets or strips full depth of cavity and installed to full height of cavity.

F. Exterior Drainage Board: Where indicated in the drawings, provide MEL-DRAIN 5012 or approved equal drainage board on exterior side of CMU foundation wall. Install per manufacturer’s written instructions and recommendations.

2.9. CAVITY-WALL INSULATION

A. Spray polyurethane foam in accordance with Division 07.

2.10. MASONRY CLEANERS.

A. 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 cleaner manufacturer and manufacturer of masonry units being cleaned.

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. ProSoCo, Inc.(Basis of Design)

b. Diedrich Technologies, Inc.

c. EaCo Chem, Inc.

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.
2. Use portland cement-lime mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime mortar.
4. For reinforced masonry, use portland cement-lime mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

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 C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type S.
3. For mortar parge coats, use Type S.
4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
5. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement by weight.
3. Application: Use pigmented mortar for exposed mortar joints with the following units:
    a. Color to be proposed by mason, selected/confirmed by Owner.

E. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2500 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

F. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

1. Application: Use epoxy pointing mortar for exposed mortar joints with the following units:

a. Pre-faced CMUs.

b. Glazed structural-clay facing tile.

PART 3 - EXECUTION

3.1. INSTALLATION, GENERAL

A. 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.

B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

C. Thickness: Build cavity walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.

D. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

E. Leave openings for equipment to be installed before completion of masonry. After installation of equipment, complete masonry to match construction immediately adjacent to the opening.

F. Strike all joints including those below grade and above ceilings.

3.2. TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.

2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.

3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.

2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

C. Joints:

1. For 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.

2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.

3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.3. 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 Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

E. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.4. MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.

2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.

3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.

1. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units 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. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.5. CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. of wall area spaced not to exceed 16 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
2. 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 (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.
    c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.

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. Parge cavity face of backup wythe in a single coat approximately 3/8 inch thick. Trowel face of parge coat smooth.

D. Coat cavity face of backup wythe to comply with Section 071413 "Cold Fluid-Applied Dampproofing."

E. Apply air barrier to face of backup wythe to comply with Section 072700 "Air Barriers." Section 071413 "Dampproofing and Waterproofing."

F. 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.

3.6. MASONRY JOINT REINFORCEMENT

A. General: 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 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7. ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.

2. Anchor masonry with anchors embedded in masonry joints and attached to structure.

3. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally.

3.8. ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors through spray foam insulation to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.

2. Embed connector sections and continuous wire in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of the spray foam insulation.

3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.

4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally with not less than 1 anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

3.9. FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, and at all obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and all obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

2. 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.

3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.

4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.

C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.
2. Space weep holes 20 inches o.c. maximum unless otherwise indicated.
3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.

D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

E. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.10. 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. Limit height of vertical grout pours to not more than 60 inches.

3.11. FIELD QUALITY CONTROL

A. Testing and Inspecting: Contractor will engage special inspectors to perform tests and inspections and prepare reports. 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 shall be done at Contractor's expense.

B. Inspections: Level 2 special inspections according to ACI 530.

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 Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.

F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

H. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

I. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.12. PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in 2 uniform coats to a total thickness of 3/4 inch.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface. Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.13. REPAIRING, POINTING, AND CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Protect surfaces from contact with cleaner.
3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.14. MASONRY WASTE DISPOSAL

A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Do not dispose of masonry waste as fill within 18 inches of finished grade.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1. DESCRIPTION

A. Related Documents:

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

B. Summary:

1. Section Includes:

a. Structural steel.

b. Grout.

C. Related Sections:

1. Section 014000 "Quality Requirements" for independent testing agency procedures and administrative requirements.

2. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.

3. Structural Steel fabricator is to review the shop drawings of other trades which will be affected by the structural framing (i.e. elevator requirements and clearances, cold form metal framing, curtain wall, etc.) and prepare the steel shop drawings to accommodate the related systems.

D. DEFINITIONS

1. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.2. PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using details indicated.

2. Use ASD; data are given at service-load level.

1.3. ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.

2. Include embedment drawings.

3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.

4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

1.4. INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and fabricator.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

F. Source quality-control reports.

1.5. QUALITY ASSURANCE

A. Fabricator Qualifications: Fabricator must provide evidence of a written quality control program which contains all the elements addressed in the AISC certification standards. The company must be able to provide acceptable work references evidencing they have worked as a steel fabricator of good standing for five years or more, and the company must provide evidence of previous work experience with Charles County Public Schools delivering a comparable scope of work in size and sophistication.

B. Installer Qualifications: Installer must provide evidence of a written quality control program which contains all the elements addressed in the AISC certification standards. The company must be able to provide acceptable work references evidencing they have worked as a steel erector of good standing for five years or more, and the company must provide evidence of previous work experience with Charles County Public Schools delivering a comparable scope of work in size and sophistication.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. Preinstallation Conference: Conduct conference at Project site.

1.6. DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

B. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

C. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.

2. Clean and relubricate bolts and nuts that become dry or rusty before use.

3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.7. COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of 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 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M.

B. Channels, Angles, Shapes: ASTM A 36/A 36M or ASTM A 572/A 572M, Grade 50.

C. Plate and Bar: ASTM A 36/A 36M or ASTM A 572/A 572M, Grade 50.

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

E. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

B. Finish: Plain.

C. Headed Anchor Rods: ASTM F 1554, Grade 55, straight.

1. Nuts: ASTM A 563 heavy-hex carbon steel.

2. Plate Washers: ASTM A 36/A 36M carbon steel.

3. Washers: ASTM F 436, Type 1, hardened carbon steel.

4. Finish: Plain.

D. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 heavy-hex carbon steel.

2. Washers: ASTM F 436, Type 1, hardened carbon steel.

3. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

2.3. PRIMER

A. Primer: Comply with Section 099100 Painting.

B. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

C. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.4. GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5. FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

1. Fabricate beams with rolling camber up.
2. Mark and match-mark materials for field assembly.
3. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

C. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

D. Bolt Holes: Cut, drill or punch standard bolt holes perpendicular to metal surfaces.

E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6. SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

B. Joint Type: Snug tightened.

C. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

D. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7. SHOP PRIMING

A. See architectural requirements to determine if shop priming is required. Structurally, steel surfaces in interior, protected locations typically do not require shop priming.

B. Shop prime steel surfaces where indicated on architectural contract documents, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
4. Galvanized surfaces.

C. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

D. SSPC-SP 2, "Hand Tool Cleaning."

2.8. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.9. GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.
3. Galvanize permanently exposed exterior structural steel, including associated connection angles, connectors, bearing plates, etc.
4. All steel exposed to the exterior is to be hot dipped galvanized.

2.10. MARYLAND BUY AMERICAN STEEL ACT

A. All steel purchased for this project is to comply with the Buy American Steel Act: Sections 17-301 to 17-306 of the Finance and Procurement Article of the Annotated Code of Maryland.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. 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/D1.1M and manufacturer's written instructions.

3.4. FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

B. Joint Type: Snug tightened.

C. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

D. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.

D. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

F. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

G. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6. REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Painting: Cleaning and touchup painting are specified in Section 099123 "Interior Painting."

END OF SECTION

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1. DESCRIPTION

A. Furnish all labor, materials, tools, equipment and services necessary for and reasonably incidental to complete the metal fabrication work as indicated on the drawings, or specified, including but not limited to the following:

1. Anchor Bolts
2. Lintels and Angle Frames

1.2. WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Section 033000: Cast-In-Place Concrete: Metal fabrications to be cast in concrete.

B. Section 042000: Unit Masonry: Metal fabrications to be embedded in masonry.

1.3. RELATED SECTIONS

1. 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.
2. In addition to other requirements specified, upon the Owner's request uncover work to provide for inspection by the Owner of covered work, and remove samples of installed materials for testing.

C. Do not cut or alter work performed under separate contracts without the Owner's written permission.

B. Section 033000: Cast-In-Place Concrete

C. Section 042000: Unit Masonry

D. Section 099100: Painting

1.4. SUBMITTALS

A. Shop drawings and material submittals shall be in accordance with the requirements of Section 013300.

B. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners and accessories.

C. Include erection drawings, elevations and details where applicable.

D. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.

PART 2 - PRODUCTS

2.1. MATERIALS

A. Steel Sections: ASTM A36 (Minimum)

B. Bolts, Nuts and Washers: ASTM A307 and/or A325

C. Welding Materials: AWS Dl.l; type required for materials being welded

D. Primer: FS TT-P-31, red; for shop application and field touch-up

E. Touch-up Primer for Galvanized Surfaces: FS TT-P641 or TT-P-645

F. Concrete Inserts: Galvanized

G. Galvanized Metal:

1. Iron and steel hardware: ASTM A 153
2. Rolled, pressed and forged steel: ASTM A 123
3. Assembled steel products: ASTM A 386

H. Aluminum Sheet: Alloy and temper recommended by manufacturer for intended use and suitable for application of finish indicated, but with not less than the strength and durability properties specified in ASTM B 209 (ASTM B 209M) for 5005-H15.

2.2. FABRICATION

A. Verify dimensions on site prior to shop fabrication.

B. Fabricate items with joints tightly fitted and secured.

C. Fit and shop assemble in largest practical sections, for delivery to site.

D. Grind exposed welds flush and smooth with adjacent finished surface. Ease exposed edges to small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of structure, except where specifically noted otherwise.

F. Make exposed joints butt tight, flush and hairline.

G. Supply components required for anchorage of metal fabrications. Fabricate anchorage and related components of same material and finish as metal fabrication, except where specifically noted otherwise.

H. Fabricate joints that will be exposed to weather in a manner to exclude water.

I. Prepare metal for shop finish in accordance with SSPC SPI-Solvent cleaning.

2.3. LINTELS AND ANGLE FRAMES

A. Steel lintels and angle frames shall be of sizes indicated on the drawings.

B. Angle lintels shall have a minimum bearing of 8" at each end.

C. Exposed metals to be painted, colors as indicated in the drawings.

2.4 FINISHES (Unless noted otherwise)

A. Clean surfaces of rust, scale, grease and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact bond with concrete or where field welding is required.

C. Prime paint items scheduled with one coat.

D. All exposed exterior miscellaneous metals items shall be hot-dipped galvanized, G-90.

2.5 MARYLAND BUY AMERICAN STEEL ACT

A. All steel purchased for this project is to comply with the Buy American Steel Act: Sections 17-301 to 17-306 of the Finance and Procurement Article of the Annotated Code of Maryland.

PART 3 - EXECUTION

3.1. PREPARATION

A. Obtain approval of Owner prior to site cutting or making adjustments not scheduled.

B. Clean and strip site primed steel items to bare metal where site welding is scheduled.

C. Make provision for erection loads with temporary bracing. Keep work in alignment.

D. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate sections.

3.2. INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Perform field welding in accordance with AWS Dl.l.

C. After installation, touch-up field welds, scratched or damaged surfaces with primer.

D. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect sheet metal surfaces and to make a weathertight connection.

E. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

F. Install concealed gaskets, joint fillers, insulation and flashings as the work progresses to make work weatherproof, soundproof or lightproof as required.

G. Corrosion Protection: Coat concealed surfaces of aluminum, zinc-coated and nonferrous metals that will be in contact with grout, concrete, masonry, wood or dissimilar metals, with a heavy coat of bituminous paint.

H. Before shipment to the project site, complete all Aluminum Composite Fascia Panel fabrication, assembly and finishing. Components not completely fabricated and assembled are not permitted. Design, fabricate, assemble and erect system, including sealed joints with adjoining work, free of water leakage.

3.3. ADJUSTING

A. 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 as required.

3.4. PROTECTION

A. Protect finishes of sheet metal fabrications from damage during construction period. Remove temporary protective coverings at the time of Substantial Completion.

END OF SECTION

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1. SUMMARY

A. Section Includes:

1. Rooftop equipment bases and support curbs.
2. Wood blocking, cants, and nailers.
3. Wood furring and grounds.
4. Wood sleepers.
5. Plywood backing panels.

1.2. SUBMITTALS

A. Provide all information requested as one submittal. Incomplete submittals will be returned without being reviewed.

B. Product Data: For each type of process and factory-fabricated product.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements

C. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

D. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Engineered wood products.
3. Power-driven fasteners.
4. Powder-actuated fasteners.
5. Expansion anchors.
6. Metal framing anchors.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded 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. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent, unless otherwise indicated.

C. Engineered Wood Products: Provide 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: Provide engineered wood products with allowable design stresses, as published by manufacturer, that 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. WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

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, stripping, and similar concealed members in contact with masonry or concrete.

3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.

4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.

5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

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 E 84, 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 D 2898. 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 D 3201 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 D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 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, mark end or back of each piece.

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 all rough carpentry unless otherwise indicated.

2.4 MISCELLANEOUS LUMBER

A. General: 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. For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine; No. 2 grade; SPIB.
2. Eastern softwoods; No. 2 Common grade; NeLMA.
3. Northern species; No. 2 Common grade; NLGA.
4. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

2.5 PLYWOOD BACKING PANELS

D. Equipment Backing Panels: DOC PS , fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FASTENERS

E. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

F. Power-Driven Fasteners: NES NER-272.

G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

2.7 METAL FRAMING ANCHORS

H. 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:

I. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Cleveland Steel Specialty Co.
2. KC Metals Products, Inc.
3. Phoenix Metal Products, Inc.
4. Simpson Strong-Tie Co., Inc.
5. USP Structural Connectors.

J. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those of basis-of-design products. 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.

K. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

L. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

2.8 MISCELLANEOUS MATERIALS

M. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

N. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

O. Retain "Flexible Flashing" Paragraph below if required as a separator between preservative-treated wood and metal decking.

P. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

2.9 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

2.10 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying 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 Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, 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 (3.2 m) beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.

2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. 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 D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

4. Design Value Adjustment Factors: Treated lumber plywood shall be tested according ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

2.11 ROOF SHEATHING

A. Plywood Roof Sheathing: Exterior, Structural I.

1. Span Rating: Not less than 16/0.

2. Nominal Thickness: Not less than 1/2 inch or as indicated in drawing, whichever is greater.

PART 3 - EXECUTION

3.1. INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring,]nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

C. Do not splice structural members between supports unless otherwise indicated.

D. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

E. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Retain one of two subparagraphs below, with or without subparagraph above, as required to comply with requirements of Project and local codes.
3. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
4. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

3.2. PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes sufficiently wet that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 071413 - DAMPPROOFING AND WATERPROOFING

PART 1 - GENERAL

1.1. DESCRIPTION

A. Furnish all labor, materials, tools, equipment and services necessary for and reasonably incidental to complete the dampproofing and waterproofing work as indicated on the drawings or specified, including but not limited to the following:

1. Dampproofing of masonry foundation walls below grade.

1.2. RELATED SECTIONS

1. 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.
2. In addition to other requirements specified, upon the Owner's request uncover work to provide for inspection by the Owner of covered work, and remove samples of installed materials for testing.
3. Do not cut or alter work performed under separate contracts without the Owner’s written permission.

B. Section 04 Section: Unit Masonry

C. Division 07 Sections: Thermal Insulation

1.3. QUALITY ASSURANCE

A. Manufacturer: Manufacturer with not less than three years of experience in the manufacture of materials required for the work.

B. Installer: Specializing in the installation of dampproofing and waterproofing, with three years of experience; acceptable to the manufacturer.

C. Contractor is not to backfill wall until either the Owner signs off on completion of dampproofing. Sign off of work is only a visual inspection to confirm that dampproofing has been installed.

1.4. SUBMITTALS

A. Materials submittals shall be in accordance with the requirements of Division 01.

1.5. JOB CONDITIONS

A. Proceed with dampproofing and waterproofing work only after substrate construction and penetrating work have been completed.

B. Examine substrate and conditions under which dampproofing and waterproofing work is to be performed and notify Contractor in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

1.6. GUARANTEE

A. Provide written guarantee agreeing to, within guarantee period, replace/repair defective materials and workmanship defined to include instances of leakage of water, abnormal aging or deterioration of materials and other failures of waterproofing systems to perform as required. Guarantee includes responsibility for removal and replacement of work which conceals waterproofing and dampproofing.

1. Guarantee period is five years after date of Substantial Completion.

PART 2 - PRODUCTS

2.1. MATERIALS

A. The Basis of Design for dampproofing and waterproofing are as manufactured by Karnak Corp.

1. Dampproofing: Karnak 220 Fibrated Dampproofing
2. Waterproofing: Karnak One-Kote.
3. Masonry Face Brick Sealant: Hydrosa.
4. Or approved equal

PART 3 - EXECUTION

3.1. PREPARATION OF SUBSTRATE

A. Surfaces to which dampproofing and waterproofing are to be applied shall be cleaned and prepared as recommended by the manufacturers of the products. The start of the application of dampproofing and waterproofing will constitute acceptance of the surfaces by the Installer.

3.2. APPLICATION OF DAMPPROOFING

A. Dampproofing shall be applied to foundation walls.

B. Dampproofing shall be applied to dry, clean, reasonably smooth surfaces, free of dirt, dust, voids, cracks and sharp projections. All voids in masonry joints in walls above grade to be filled prior to application of dampproofing.

C. Dampproofing shall be applied to required surfaces in accordance with the manufacturer's printed recommendations.

3.3. APPLICATION OF WATERPROOFING

A. Waterproofing shall be applied in accordance with the manufacturer's printed recommendations.

B. Provide protection board to surface of elevator pit walls after applying waterproofing before backfilling.

C. Upon completion of the application of the waterproofing, the surfaces shall be inspected by a representative of the manufacturer in order to certify, in writing, that the waterproofing was applied in accordance with the manufacturer's recommendations.

3.4 FACE BRICK SEALANT

A. Sealant applied over masonry face brick- two applications. Application rate shall be 300 sf per gallon or as recommended by manufacturer.

3.5 PROTECTION OF ADJACENT SURFACES

A. During application of dampproofing and waterproofing care shall be exercised to prevent damage to adjacent surfaces that are not to receive dampproofing and waterproofing. Any damage to adjacent surfaces damaged by the application of dampproofing and waterproofing shall be cleaned or repaired or replaced to the satisfaction of the Architect.

END OF SECTION 071413

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1. DESCRIPTION

A. Furnish all labor, materials, tools, equipment and services necessary for and reasonably incidental to complete the building insulation work as indicated on the drawings or specified, including but not limited to the following:

1. Rigid Plastic Insulation
2. Sound Attenuation Insulation
3. Batt Insulation

1.2. RELATED SECTIONS

1. 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.
2. In addition to other requirements specified, upon the Owner’s request uncover work to provide for inspection by the Owner of covered work, and remove samples of installed materials for testing.
3. Do not cut or alter work performed under separate contracts without the Owner's written permission.

B. Section 033000: Cast-In-Place Concrete

C. Section 042000: Unit Masonry (Foundation wall/slab perimeter insulation)

D. Section 072713: Spray Polyurethane Foam and Sheet Air-Vapor Barrier (where indicated in drawings)

1.3. QUALITY ASSURANCE

A. Thermal Conductivity: Thicknesses indicated are for thermal conductivity (k-value at 75 deg. F. specified for each material). Provide adjusted thickness for equivalent use of material having a different thermal conductivity. Where insulation is identified by "R" value, provide thickness required to achieve indicated values.

1.4. SUBMITTALS

A. Material submittals shall be in accordance with the requirements of Division 01.

1.5. PRODUCT HANDLING

A. General Protection: Protect insulation from physical damage and from becoming wet, soiled or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation.

PART 2 - PRODUCTS

2.1. MATERIALS

A. Rigid Plastic Insulation: Extruded polystyrene, ASTM Spec C578, square edges, 24” x 48” x 1” thick, Formula 250 / Owens Corning, Amoco Foam Products Co, UC Industries / US Gypsum

D. Fiberglass Batt Insulation: foil faced ASTM C665, thickness to match depth of stud. Minimum R-13 for 3-5/8” studs and R-19 at 6” studs.

E. Pherolic foam shall not be used.

F. Polyisocyanurate Board Insulation: Closed cell polyisocyanurate foam with black glass reinforced mat laminated to faces, complying with ASTM C 1289 Type II Class 1.

PART 3 - EXECUTION

3.1. INSPECTION AND PREPARATION

A. Examine substrates and conditions under which insulation work is to be performed and notify Owner, in writing, of unsatisfactory conditions. Do not proceed with insulation work until unsatisfactory conditions have been corrected.

B. Clean substrates of substances harmful to insulation or vapor barriers, including removal of projections which might puncture vapor barriers.

C. Schedule review by Owner of initial installation of insulation prior to complete installation. Do not cover up any insulation until reviewed by Owner.

3.2. INSTALLATION

A. Comply with manufacturer's instructions for particular conditions of installation in each case.

B. Extend single layer insulation full thickness as shown over entire area to be insulated. Edge joints between each layer of insulation shall be staggered. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections which interfere with placement.

3.3. SCHEDULE

A. 2" Min R-10 Rigid Plastic Insulation shall be installed on interior face of foundation walls below grade and below perimeter of floor slabs as indicated on the drawings.

B. Floor Penetration Insulation shall be installed around all pipes and ducts penetrating floor slabs.

C. Fiberglass Batt Insulation may be used for **floor** insulation (areas over exterior overhangs) in lieu of sprayfoam/rigid insulation where allowed by the drawings; ref Sheet A-4.

3.4. PROTECTION

A. General: Protect installed insulation from harmful weather exposures and from possible physical abuses, where possible, by non-delayed installation of concealing work or, where that is not possible, by temporary covering or enclosure. Installer shall advise Contractor of exposure hazards, including possible sources of deterioration and fire hazards.

END OF SECTION 071200

SECTION 072713

SPRAY POLYURETHANE FOAM AND SHEET AIR/VAPOR BARRIER

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section includes the following:

1. Materials and installation methods for a spray polyurethane foam building insulation and air/vapor barrier system located in the non-accessible part of the wall.
2. Materials and installation to bridge and seal the following air leakage pathways and gaps:
   a. Connections of the walls to the roof air barrier.
   b. Connections of the walls to the foundations.
   c. Expansion joints.
   d. Openings and penetrations of window frames, store front, curtain wall.
   e. Barrier precast concrete and other envelope systems.
   f. Door frames.
   g. Piping, conduit, duct and similar penetrations
   h. Masonry ties, screws, bolts and similar penetrations.
   i. All other air leakage pathways in the building envelope.
3. Materials to act as flashings and counterflashings.

1.2 RELATED SECTIONS

A. Section 033000 - Cast-In-Place Concrete:

1. Concrete back-up walls
2. Underslab vapor retarder.

B. Section 042000 - Unit Masonry:

1. Masonry backup walls
2. Masonry veneer cavity walls.

C. Section 071413 – Dampproofing and Waterproofing.

D. Section 072100 – Thermal Insulation.

E. Section 079200 - Joint Sealants.

F. Section 081113 – Hollow Metal Doors and Frames.

G. Section 092900 - Gypsum Board Systems

1.3 PERFORMANCE REQUIREMENTS

A. Provide air/vapor barrier system constructed to perform as a continuous air/vapor barrier system, as building thermal insulation, and as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration. System shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air seal materials at such locations, changes in substrate and perimeter conditions.

B. System shall comply with the following:

1. Moisture Control:

a. A vapor barrier having a maximum permeability of zero point one (0.1) perm or less (equivalent to a 4 mil polyethylene sheet) shall be installed on the winter warm side of walls, ceilings and floors enclosing a conditioned space. All joints, holes, imperfections and penetrations of the vapor barrier shall be taped tight with a vapor barrier tape recommended by the vapor barrier manufacturer.
   1) Exception 3: Envelope systems that maintain the moisture content of all building materials that comprise the assembly, below the equilibrium moisture content the materials would achieve when exposed to relative humidity of 80%. For calculation purposes use Chapter 22 in 1997 ASHRAE Fundamentals Handbook, "Mathematical Models". Assume interior air temperature and humidity specified in 1303.3.

2. The building envelope shall be constructed with a continuous air barrier to control air leakage into, or out of the conditioned space. The air barrier shall have the following characteristics:
   a. It must be continuous, with all joints made air-tight.
   b. It (the material used) shall have an air permeability not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 0.3 in. water (1.57 psf) (0.02 L/s.m^2 @ 75 Pa.) when tested in accordance with ASTM E2178-01
   c. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load. The air barrier shall be joined in an airtight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:
      1) Foundation and walls.
      2) Walls and windows or doors.
      3) Different wall systems.
      4) Wall and roof.
      5) Wall and roof over unconditioned space.
      6) Walls, floor and roof across construction, control and expansion joints.
      7) Walls, floors and roof to utility, pipe and duct penetrations.
3. Air Barrier Penetrations: All penetrations of the air barrier and paths of air infiltration / exfiltration shall be made air-tight.

C. Provide a system that has been tested in accordance with the Air Barrier Association of America's (ABAA's) testing protocol, to provide system air leakage results not to exceed:

1. 0.01 cfm/sf @ 1.57 psf (0.05 L/s/M2 @ 75 Pa)

2. Note: This requirement refers to laboratory material/assembly testing, not project-specific testing.

1.4 SUBMITTALS

A. Provide submittals in accordance with Division 01. Provide all information below as one submittal. Incomplete submittals will be returned not reviewed.

1. Provide evidence of licensing and certification under the Air Barrier Association of America's (ABAA's) Quality Assurance Program.
2. Submit shop drawings showing locations and extent of air/vapor barrier and details of all typical conditions, intersections with other envelope systems and materials, membrane flashings and counter-flashings, and details showing how gaps in the construction will be bridged, how inside and outside corners are negotiated and how miscellaneous penetrations such as conduits, pipes electric boxes and the like are sealed.

3. Submit manufacturer's product data sheets for each type of material, including manufacturer's printed instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, technical data, and tested physical and performance properties.
4. Submit manufacturer's installation instructions.
5. Provide evidence of testing by an accredited laboratory confirming material has been tested and conforms to the requirements of ASTM E2178, Standard for Air Barrier Materials.
6. Provide evidence of testing by an accredited laboratory confirming material has been tested and conforms to the requirements of ASTM E2357, Standard for Air Barrier Materials.
7. Certification by air/vapor barrier manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
8. Certification of compatibility by air/vapor barrier manufacturer, listing all materials on the project that it connects to or that come in contact with it.
9. Submit two samples, 12 by 12 inch (300 by 300 mm) minimum size, of each air/vapor barrier material required for Project.
10. Submit test results of air permeability testing of primary air barrier material (ASTM E 2178-01)
11. Submit test results of assembly in accordance with ABAA test protocol.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. The air barrier contractor shall be, during the bidding period as well as for the duration of the installation, officially recognized as a Licensed Contractor by the Air Barrier Association of America (ABAA). The contractor shall carry liability insurance and bonding.
2. Each worker who is installing air barriers must be either a Certified Applicator or an installer who is registered with ABAA
3. Each Lead Certified Applicator can supervise a maximum of five registered installers. The Certified Applicator shall be thoroughly trained and experienced in the installation of air barriers of the types being applied. Lead Certified Applicators shall perform or directly supervise all air/vapor barrier work on the project.
4. Air/vapor barrier installers must be trained and certified by ABAA/NECA (National Energy Conservation Association) and PSDI (Professional Skills Development Institute for energy conservation) in accordance with the training requirements outlined in the ULC S705.2-02 Installation Standard. Installers shall have their photo-identification certification cards in their possession and available on the project site, for inspection upon request.

B. Single-Source Responsibility: Obtain air/vapor barrier materials from a single manufacturer regularly engaged in manufacturing the product.

C. Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).

D. Preconstruction Meeting: Convene two (2) weeks prior to commencing Work of this section, in accordance with Division 01 meeting requirements.

E. Cooperate and coordinate with the Owner's inspection and testing agency. Do not cover any installed air and vapor barrier unless it has been inspected, tested and approved.

F. Protect people and materials from over-spray and contact with chemicals and gases.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product, date of manufacture, expiration date, and directions for storage.

B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air/vapor barrier manufacturer. Protect stored materials from direct sunlight.

C. Avoid spillage. Immediately notify Owner if spillage occurs and start clean up procedures.

D. Clean spills and leave area as it was prior to spill.

1.7 WASTE MANAGEMENT AND DISPOSAL

A. Separate and recycle waste materials in accordance with the Waste Reduction Workplan.

B. Place materials defined as hazardous or toxic waste in designated containers.

C. Ensure emptied containers are sealed and stored safely for disposal away from children.

1.8 PROJECT CONDITIONS

A. Environmental Conditions: Apply air/vapor barrier within range of ambient and substrate temperatures recommended by air/vapor barrier manufacturer. Do not apply air/vapor barrier to a damp or wet substrate, unless the manufacturer specifically permits that for the product.
   1. Do not apply air/vapor barrier in snow, rain, fog, or mist.
   2. Do not apply air/vapor barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the manufacturer.
   3. The product shall not be installed after the expiry date printed on the label of each container. The product has a shelf life of 6 months from the date of manufacture.

1.9 WARRANTY

A. For sealant and membrane materials, provided minimum two year warranty, except as noted below.

B. Material Warranty: Provide the manufacturer’s three year air/vapor barrier material warranty.

C. System Warranty: Provide the manufacturer’s three year system warranty, including the primary air/vapor barrier and installed accessory sealant and membrane materials which fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 - PRODUCTS

2.1 MATERIALS & MANUFACTURERS

1. Sprayed polyurethane foam air barrier wall systems are manufactured on the jobsite by trained, certified contractor manufacturers. The Contractor, Manufacturer must be certified by the Air Barrier Association of America (ABAA) and provide trained certified mechanics with a demonstrated ability to manufacture air barrier system on project of similar size, scope and complexity.

2. Air Barrier System Assembly Testing –Air Barrier SPF must pass ASTM-2357-05 for Steel Stud Frame Construction and Masonry Construction.
3. Sprayed polyurethane foam material shall meet the requirements of ASTM E-84 Class I Rating up to 4" thickness
   a. Flame Spread of 25 or better
   b. Smoke Development Index of 350 or better
4. SPF Air Barrier must pass NFPA 285 and NFPA 286
5. Design R value as indicated in test report; minimum R-6.7/inch.
   a. Install in thickness required to meet minimum R-values indicated in the drawings.
6. Density as indicated in test report: 1.9 pounds per cubic foot.
7. Products that meet the preceding requirements:
   a. BASF Walltite® performance properties are used as the design standard or equal

2.2 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended by air/vapor barrier manufacturer for intended use and compatible with the air/vapor barrier.

B. Self-adhering modified asphalt/polyethylene flashing to counterflash metal flashings:

1. Blueskin TWF by Henry Company.

C. Primer: Water based liquid primer for concrete, masonry, gypsum sheathing, wood, metal, and painted substrates;

1. Aquatac as manufactured by Henry Company

D. Primer: Solvent based, VOC compliant primer for concrete, masonry, gypsum sheathing, wood, metal, and painted substrates;

1. Blueskin Primer by Henry Company.

E. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes by SRAB air/vapor barrier manufacturer.

F. Stainless-Steel Sheet Flashing: ASTM A167, Type 304, soft annealed, with No. 2D finish; minimum, 0.0156 inch thick.

G. Transition Strip:. Self-adhering, smooth surfaced SBS modified bitumen membrane, nominal 40 mil thickness, width as required.

1. Blueskin SA as manufactured by Henry Company
2. Referenced in drawings as "Self-Adhesive Waterproofing Membrane", "Waterproofing Membrane," etc.

H. Transition Strip Primer:

1. Blueskin Adhesive as manufactured by Henry Company
2. Aquatac Primer as manufactured by Henry Company

I. Sheet Membrane Transition Strip Termination Sealant:

1. Polybitume 570-05 by Henry Company

J. Sheet Membrane Air Barrier Perimeter Seal to Windows, Doors, Curtainwall and Storefront systems: Non-reinforced, cured chloroprene polymer sheet (neoprene) complying with ASTM D2000 Designation 2BC415 to 3BC620, 65 mils thick.

1. Adhesive: Typical contact-type adhesive used for fully-adhered membranes.
2. Lap Sealant: Typical urethane or silicone lap and termination sealant used for membrane edges recommended by manufacturer.
3. Termination bars and fasteners:
   a. Aluminum bars and stainless fasteners.
   b. Sheet Membrane Sheet Membrane Air Barrier Perimeter Seal to Windows, Doors, Curtainwall and Storefront systems: Low modulus silicone sheet; provide manufacturer's standard system consisting of precured low-modulus silicone extrusion, in sizes to fit widths indicated, combined with a neutral-curing low modulus silicone sealant for bonding extrusions to substrates.
4. Pecora Sil-Span.
5. Dow 1-2-3 or equal.

K. Provide sealants in accordance with Section 07900 - Joint Sealers. Comply with ASTM C920 and ASTM C920 classifications for type, grade, class, and uses

1. Silicone Sealant [Type A]:, natural cure, low modulus, to seal sheet membrane flashing to polyethylene face of sheet rubberized-asphalt barrier and to seal between and to non-bituminous sheet systems.
   a. Acceptable materials:
      1) Dow 790
      2) Pecora 864
   b. SPF (Sprayed Polyurethane Foam) Sealant: Provide one- or two-component, foamed-in-place, polyurethane foam sealant with the following characteristics:
      1) Density: 1.5 to 2.0 PCF.
      2) Flame Spread (ASTM E162): 25 or less.
      3) Initial R-Value (at 1 inch): Not less than 7.
         Acceptable materials:
         a) Zerodraft Foam Sealant.
         b) Zerodraft Insulating Air Sealant
         Zerodraft (Division of Canam Building Envelope Specialists Inc.), 125 Traders Blvd. E., Unit # 4, Mississauga, ON, L4Z 2H3 Tel. 1-877-272-2626
2. Substrate Cleaner: Non-corrosive type recommended by sealant manufacturer, compatible with adjacent materials.

2.3 EQUIPMENT

1. The equipment used to spray the polyurethane foam material shall be in accordance with ULC S705.2-02 and the equipment manufacturer’s recommendations for specific type of application.
2. Equipment settings are to be recorded on the Daily Work Record as required by the ULC S705.2-02 Installation standard.
3. Each proportioner unit to supply only one spray gun.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions under which air/vapor barrier systems will be applied, with Installer present, for compliance with requirements. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.

1. Do not proceed with installation until after minimum concrete curing period recommended by air/vapor barrier manufacturer.
2. Ensure that:

a. surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants
b. concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions.
c. masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.

3. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.
4. Notify Owner in writing of anticipated problems using air/vapor barrier over substrate.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air/vapor barrier application.

B. Prime masonry, concrete substrates with conditioning primer when installing modified asphalt membrane transition membranes.

C. Prime glass-fiber surfaced gypsum sheathing an adequate number of coats to achieve required bond to transition membranes, with adequate drying time between coats.

D. Prime wood, metal, and painted substrates with primer recommended by membrane manufacturer.

E. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air/vapor barrier and at protrusions according to air/vapor barrier manufacturer's written instructions and approved tested system in accordance with ABAA air barrier testing protocol.

1. Verify that surfaces and conditions are suitable to accept work as outlined in this section.
2. Prior to commencement of work report in writing to the architect any defects in surfaces or conditions that may adversely affect the performance of products installed under this section.
3. Commencement of work outlined in this section shall be deemed as acceptance of existing work and conditions.
4. Examine joints before sealing to ensure configurations, surfaces and widths are suitable for spray polyurethane foam. Report in writing all defects stating the locations of joints deemed unacceptable for the application of the spray polyurethane foam.

3.3 PREPARATION

A. Protection:

1. Mask and cover adjacent areas to protect from over spray.
2. Ensure any required foam stop or back up material are in place to prevent over spray and achieve complete seal.
3. Seal off existing ventilation equipment. Install temporary ducting and fans to ensure exhaust fumes. Provide for make-up air.
4. Erect barriers, isolate area and post warning signs to advise non-protected personnel to avoid the spray area.

B. Surface Preparation

1. Surfaces to receive foam insulation shall be clean, dry and properly fastened to ensure adhesion of the polyurethane foam to the substrate.
2. Ensure that all work by other trades that may penetrate through the air barrier system is in place and complete.

3. Ensure that surface preparation and any primers required conform to the manufacturers instructions.
4. Prepare surfaces by brushing, scrubbing. Scraping, or grinding to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion and integrity of the spray polyurethane foam. Wipe down metal surfaces to remove release agents or other non-compatible coatings, using clean sponges or rags soaked in a solvent compatible with the spray polyurethane foam. Ensure surfaces are dry before proceeding.
5. Install transition membranes to all applicable surfaces and ensure proper adhesion of the transition membranes to the substrate, capable of having spray polyurethane foam insulation.
6. Install counter-flashings”
   a. Metal: Mechanically fasten metal counter-flashings with screws at 8” (200 mm) o.c.
   b. Membrane: Cut into and uncover only 3” of siliconized release paper along one edge of the counter-flashing membrane. Adhere membrane flashing to the pre-primed substrate a minimum of 3” and roll firmly in place.
7. Ensure veneer anchors are in place.

3.4 APPLICATION:

1. Spray-application of polyurethane foam shall be installed in accordance with ULC S705.2-02 and the manufacturer’s instructions.
2. Apply only when surfaces and environmental conditions are within limits prescribed by the material manufacturer and the ULC S705.2 Installation standard.
3. Apply in consecutive passes as recommended by manufacturer to thickness as indicated on drawings. Passes shall be not less than 1/2 inch and not greater than 2 inches.
4. Do not install spray polyurethane foam within 3 inches of heat emitting devices such as light fixtures and chimneys.
5. Finished surface of foam insulation to be free of voids and embedded foreign objects.
6. Remove masking materials and over spray from adjacent areas immediately after foam surface has hardened. Ensure cleaning methods do not damage work performed by other sections.
7. Trim, as required, any excess thickness that would interfere with the application of cladding/covering system by other trades.
8. Clean and restore surfaces soiled or damaged by work of the section. Consult with section of work soiled before cleaning to ensure methods used will not damage the work.
9. Do not permit adjacent work to be damaged by work of this section. Damage to work of this section caused by other sections shall be repaired by this section at the expense of the subcontractor causing the damage.
10. Complete connections to other components or repair any gaps, holes or other damage using material which conforms to ULC S710.1 Polyurethane Sealant Foam – One Component – Material or ULC S711.1 Polyurethane Sealant Foam – Two Components – Material and shall be installed in accordance with ULC S710.2 Polyurethane Sealant Foam – One component – Installation or ULC S711.2 Polyurethane Sealant Foam – Two Component – Installation, whichever is appropriate.

3.5 FIELD QUALITY CONTROL

A. Site Tests

1. The Licensed Installer shall conduct daily visual inspection, adhesion/cohesion testing and density measurements as outlined by the ULC S705.2-02 Installation standard.
2. The Licensed Installer shall complete the Daily Work Record and record all information required including the results of the testing. The Daily Work Record shall be kept on site for routine inspection. Copies of the Daily Work Record shall be forwarded to the owner or owner’s representative upon request. Copies of the Daily Work Record or monthly

summaries shall be sent to the ABAA office on a monthly basis as required by the Quality Assurance Program.

3. Transition membranes shall be pull tested in accordance with the ABAA Quality Assurance Program requirements before installing the spray polyurethane air barrier material.
4. The costs incurred for daily testing and inspection by the Licensed Installer and the completion of the Daily Work Record shall be borne by the Licensed Contractor.

B. Inspection

1. Arrange for site inspections by ABAA. The cost of inspections shall be included in the bid provided by the Licensed Contractor.
2. The ABAA site-inspections shall verify conformance with the manufacturers instructions, the standard ULC S705.2-02 Installation standard, the ABAA Quality Assurance Program, and this section of the project specification.
3. Inspections and testing shall be carried out at 5%, 50% and 95% of completion. A written inspection report shall be forwarded to the architect [the owner's representative] [the Contractor] and the ABAA-licensed installer within 3 working days of the inspection and test being performed. In the case of any deficiencies, the ABAA-licensed inspector may verbally advise the licensed installer at the time of the inspection.

4. If the inspection reveals any defects, the Licensed Contractor shall immediately rectify all such defects at his cost.

3.6 TOLERANCES

1. Maximum variation from indicated thickness: minus (-) 1/4 inch; plus (+) 1/4 inch.

3.7 PROTECTION

1. Protect the spray polyurethane foam from ultraviolet radiation when installed on the exterior of a building.
2. Cover the spray polyurethane foam with a thermal barrier when installed on the interior of the building.

END OF SECTION

SECTION 076100 - SHEET METAL ROOFING

PART 1 – GENERAL

1.01 SUMMARY

A. Furnish and install a double lock metal panel roofing system, including:
   1. Roofing manufacturer's requirements for the specified warranty.
   2. Preparation of roofing substrates.
   3. Wood nailers (FRT) as required for roofing attachment.
   4. Cover boards.
   5. Self adhering underlayment.
   6. Metal roof edging and copings.
   7. Flashings.
   8. Other roofing-related items specified or indicated on the drawings or otherwise necessary to provide a complete, water-tight roofing system.

B. Disposal of demolition debris and construction waste is the responsibility of Contractor. Perform disposal in manner complying with all applicable federal, state, and local regulations.

C. Comply with the published recommendations and instructions of the roofing system manufacturer.

1.02 RELATED SECTIONS

A. Section 06 10 00 - Rough Carpentry:
   1. Roof Sheathing: Plywood, minimum thickness required/recommended by metal roofing manufacturer, with H-clip or tongue-and-grooved joints.
   2. Perimeter wood members for attachment of edge trim.
   3. Wood nailers associated with roof insulation.

B. Section 07 27 13 – Spray Polyurethan Foam and Sheet Air-Vapor Barrier

1.03 REFERENCES

A. Referenced Standards: These standards form part of this specification only to the extent they are referenced as specification requirements.
   1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers; 2011.
   2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.
   3. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2008.
   4. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2013.
   5. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.
   6. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings; American Society for Testing and Materials; 2011.
   7. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2012.
   8. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference; American Society for Testing and Materials; 2005 (Reapproved 2012)
   9. ASTM E1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference; American Society for Testing and Materials; 1995 (Reapproved 2011).

10. ASTM E1680 - Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems; American Society for Testing and Materials; 2011.
11. MBMA - Metal Roofing Systems Design Manual; Metal Building Manufacturers Association; 2012.
12. PS 1 - Construction and Industrial Plywood; 2009.
13. PS 20 - American Softwood Lumber Standard; 2010.
14. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
15. UL 2218 - Standard for Impact Resistance of Prepared Roof Covering Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. Provide all information requested in this Section as on submittal. Incomplete submittals will be returned not reviewed.

B. Product Data: Submit manufacturer's data sheets on each product to be installed and manufacturer's standard detail drawings applicable to this project.
   1. Installation Instructions: Provide manufacturer's instructions to installer, marked up to show exactly how all components will be installed; where instructions allow installation options, clearly indicate which option will be used.

C. Samples: Submit following samples for approval:
   1. 12 inch long sample of roof panel.
   2. Roof attachment clips.
   3. Color chips for selection of finish color and sheen.
   4. After selection of finish color, provide two 3 by 5 inch metal samples finished in color selected.

D. Shop Drawings: Provide drawings prepared especially for this project for all relevant conditions, including plans and elevations, sections and details, specified loads, flashings, roof edges, terminations, expansion joints, curbs, penetrations, and drainage. Specifically include interfaces with materials not supplied by metal roof panel manufacturer and identify each component and its finish.

E. Pre-Installation Notice: Copy to show that manufacturer's required Pre-Installation Notice (PIN) has been accepted and approved by the manufacturer.

F. Manufacturer's Installation Inspection Reports: Manufacturer may, at its option, inspect the installation at any time to appraise the installing contactor of their compliance with manufacturer's requirements. Typical inspections will include:
   1. Prior to the installation of the metal roofing panels to inspect the underlayments. The roofing contractor is responsible for assuring that the substrate is in suitable condition for the installation of the metal roofing components to the substrate.
   2. Intermediate inspections to ensure proper installation of the metal roofing panels (if required).
   3. At final completion of all metal roofing system work.
   4. Submit to Owner, for the project record, a copy of each report of inspection made.

G. Executed Warranty, by authorized company official with final close-out..

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Roofing installer shall have received training from metal panel manufacturer for installation of the specified roof panel system.

B. Pre-Installation Conference: Before start of roofing work, Contractor shall hold a meeting to discuss the proper installation of materials and requirements to achieve the warranty.
   1. Require attendance with all parties directly influencing the quality of roofing work or affected by the performance of roofing work.
   2. Notify Owner well in advance of meeting.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer's original containers, dry and undamaged, with seals and labels intact and legible.

B. Exercise extreme care in unloading, storing, and installing metal panels to prevent bending, warping, twisting, and surface damage.

C. Store products above ground on well-supported platforms that provide minimum of 1:48 slope. Store under waterproof covering or indoors and provide proper ventilation of metal components to prevent condensation build-up between metal components.

1.07 WARRANTY

A. Comply with all warranty procedures required by manufacturer, including notifications, scheduling, and inspections.

B. Manufacturer's warranty is in addition to, and not a limitation of, other rights the owner may have under the contract documents.

C. Warranty: Limited Warranty covering roof panels and associated metal components, roof sheathing provided by manufacturer, and accessories, covering weathertightness, finish, materials, labor, and workmanship.

1. Limit of Liability: No dollar limitation.

2. Scope of Coverage: Repair leaks in the roofing system caused by:
   a. Ordinary wear and tear of the elements.
   b. Manufacturing defect in materials.
   c. Defective workmanship used to install these materials.
   d. Damage due to winds up to 90 mph.

3. Not Covered:
   a. Materials made by entities other than roofing manufacturer.
   b. Damage due to winds in excess of 90 mph.
   c. Damage due hurricanes or tornadoes.
   d. Hail.
   e. Intentional damage.
   f. Unintentional damage due to normal rooftop inspections, maintenance, or service.

D. Painted Finish Warranty: Provide non-prorated warranty covering durability of painted finish, to include film integrity, color change, fading, and chalking, unless otherwise indicated below.
   1. Warranty Period: 25 years commencing on date of substantial completion.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer (Basis-of-Design) – Metal Roof Panels and Associated Sheet Metal Components. Firestone Building Products LLC, Carmel, IN: www.firestonebpco.com .
   1. Provide all components of system supplied or specified by same manufacturer.
   2. Roofing systems manufactured by others may be acceptable provided the roofing system is completely equivalent in materials and warranty conditions and the manufacturer meets the following qualifications:
      a. Specializing in manufacturing the roofing system to be provided.
      b. Minimum ten years of experience manufacturing the roofing system to be provided.
      c. Able to provide a no dollar limit, single source roof system warranty that is backed by corporate assets in excess of one billion dollars.
      d. ISO 9002 certified.
      e. Able to provide waterproofing membrane underlayment.

B. Acceptable Alternative Manufacturer - Petersen Aluminum Tite-Loc Panel

C. Substitutions: Allowed per Division 01 requirements.
   1. Submit evidence that the proposed substitution complies with the specified requirements.

2.02 ROOFING SYSTEM DESCRIPTION

A. Roofing System: Standing seam metal roof panels and other components, together forming a watertight assembly having the following characteristics:

1. Warranty: 30 years
2. Panel Seam Type: Self-locking; not requiring field seaming, concealed clip attachment to substrate.
3. Panel Material: Aluminum, 0.032 inch (0.81 mm), with fluoropolymer coating.
4. Color: **Electric Blue** (Firestone) or equal approved by Owner
5. Design Loads: In accordance with ASCE 7, current edition.
   a. Design Snow Load: Not less than 30 psf.
   b. Maximum Deflection Under Snow Load: Not more than L/180 or as recommended by ASCE 7, whichever is less.
   c. Wind Uplift Resistance: Class 90 rating, minimum, when tested in accordance with UL 580.
   d. Wind Pull-Off Resistance: No failure of roof panel or fasteners when tested in accordance with ASTM E1592 for negative loading equal to negative design wind load; for assemblies not tested, capacity for gauge, span, or loading may be determined by interpolating between test values only.
6. Impact Resistance: Minimum of Class 4, when tested in accordance with UL 2218.
7. Thermal Effects: Design roof panels and their attachment to allow free movement in response to expansion and contraction forces resulting from temperature variation, as specified in the MBMA Metal Roofing Systems Design Manual.
8. External Fire Resistance: Class A when tested in accordance with ASTM E108 or UL 790.
9. Provide all necessary members and connections, whether indicated in the manufacturer's standard detail drawings or not.
10. Accessories and Fasteners: Capable of resisting the specified design wind uplift forces and allowing for thermal movement of the roof panel system, not restricting free movement of the roof panel system resulting from thermal forces except at designed points of roof panel fixity.
11. Provide discreet, clamp-to-seam snow/ice guards, provided by metal roofing manufacturer; color to match metal roofing. Refer also to drawing details.

B. Roof System Components: In order from the top down:
   1. Metal roofing panels and trim.
   2. Underlayment: Self-adhering, underlayment over entire roof; material as specified.
   3. Plywood – provide in accordance with all metal roof manufacturer’s requirements and recommendations.
   4. Roof Insulation: Refer to drawings

2.03 ROOF PANELS AND SHEET METAL FABRICATIONS

A. Roof Panels: Basis of Design: Firestone UNA-CLAD UC-3 Standing Seam Roofing; roll formed roofing panels produced in a permanent factory environment with fixed-base roll-forming equipment.
   1. Seam Height: 1.5 inches.
   2. Seam Spacing (Panel Width): 16 inches, optimal.
   2. Profile: Flat. Flat Ribs.
   3. Texture: Stiffening Beads
   4. Coler: Per Above.
   5. Clips: As tested and supplied by manufacturer.
   6. Provide factory applied integral seam sealant in leg of panel where recommended by manufacturer.
   7. Form roofing panels in longest practical lengths, true to shape, accurate in size, square, and free from distribution or manufacturing defects. Curved/arched panels will be formed by the manufacturer to the appropriate radius. Installers wishing to provide a field formed roof will NOT be considered equals. Manufacturers will have option to site form panels as conditions dictate. All site forming will be performed by the system manufacturer.

B. Aluminum Sheet For Painted and Mill Finish: ASTM B209, alloy 3003-H14/3105-H14.

C. Fluoropolymer Coating: 70 percent full strength Kynar 500/Hylar 5000.
   1. Exposed Surface: 1.0 mil plus/minus 0.1 mil total dry film thickness.
   2. Concealed Surface: 0.2 to 0.3 mils total dry film thickness.
   3. Color: To be selected from manufacturer’s standard and premium colors.

D. Sheet Metal Components Associated with Metal Roof Panels: Made by same manufacturer and compatible with roof panels; of not less than minimum thickness required by roof panel manufacturer.
   1. Fabricate trim, flashing, and accessories to roofing manufacturer's specified or approved profiles.
   2. Exposed metal components of same finish as panels.
   3. Color: Same as panels.
   4. Provide the following formed sheet metal components:
      a. Eave.
      b. Valleys
      c. Rake edge.
      d. Vertical fascia.
      e. Side wall flashing.
      f. Flashings.

2.04 ROOF INSULATION

1. Per drawings and insulation specifications.

2.05 ACCESSORY MATERIALS

A. Self-Adhered Underlayment: Rubberized sheet waterproof membrane complying with ASTM D 1970/D1970M, self-adhering.
   1. Resistance to Direct Exposure: At least 90 days.
   2. Minimum High Temperature Resistance: 230 degrees F.
   3. Water Vapor Permeance: 0.1 perm, maximum.
   4. Acceptable Product: Clad-Gard SA by Firestone

B. Fasteners: In strict accordance with metal roof panel manufacturer's requirements; minimize exposed fasteners.
   1. Fasteners Exposed to Weather: Sealed or with sealed washers on exterior side of covering to waterproof fastener penetration; washer material compatible with screw head; minimum 3/8 inch diameter washer for structural connections; gasket portion of fasteners or washers made of EPDM, neoprene, or other equally durable elastomeric material.
   2. Fasteners Exposed to View: Head of color matching panel or component in which installed.

C. Installation Clips: Manufacturer standard galvanized or stainless steel clips, as required by panel selection, for concealed securement of panels. Use only those approved for use by the roof system manufacturer.

PART 3 – EXECUTION

3.01 GENERAL

A. Install roofing, insulation, flashings, and accessories in accordance with roofing manufacturer's published instructions and recommendations for the specified roofing system. Where manufacturer provides no instructions or recommendations, follow good roofing practices and industry standards. Comply with federal, state, and local regulations.

B. Obtain all relevant instructions and maintain copies at project site for duration of installation period.

C. Verify that shop drawings prepared by metal roof panel manufacturer have been approved and are available to installers; do not use drawings prepared by others for installation drawings.

D. Verify that the specifications and drawing details are workable and not in conflict with the roofing manufacturer's recommendations and instructions; start of work constitutes acceptable of project conditions and requirements.

E. Do not start work until Pre-Installation Notice has been submitted to manufacturer as notification that this project requires a manufacturer's warranty.

F. Perform work using competent and properly equipped personnel.

G. Temporary closures, which ensure that moisture does not damage any completed section of the new roofing system, are the responsibility of the applicator. Completion of flashings, terminations, and temporary closures shall be completed as required to provide a watertight condition.

H. Install roofing only when surfaces are clean, dry, smooth and free of snow or ice; do not apply roofing during inclement weather or when ambient conditions will not allow proper application; consult

manufacturer for recommended procedures during cold weather. Do not work with sealants and adhesives when material temperature is outside the range of 60 to 80 degrees F.

I. Protect adjacent construction, property, vehicles, and persons from damage related to roofing work; repair or restore damage caused by roofing work.
   1. Protect from spills and overspray from bitumen, adhesives, sealants and coatings.
   2. Particularly protect metal, glass, plastic, and painted surfaces from bitumen, adhesives, and sealants within the range of wind-borne overspray.
   3. Protect finished areas of the roofing system from roofing related work traffic and traffic by other trades.

J. Until ready for use, keep materials in their original containers as labeled by the manufacturer.

K. Consult panel manufacturer's instructions, container labels, and Safety Data Sheets (SDS) for specific safety instructions. Keep all adhesives, sealants, primers and cleaning materials away from all sources of ignition.

3.02 EXAMINATION

A. Examine roof deck to determine that it is sufficiently rigid to support installers and their mechanical equipment and that deflection will not strain or rupture roof components or deform deck.

B. Verify that surfaces and site conditions are ready to receive work. Correct defects in the substrate before commencing with roofing work.

C. Verify that the substructure installation is in accordance with the approved shop drawings and roof panel manufacturer’s requirements, that the fasteners are correct for the substrate, and the substrate is installed to accommodate and support the appropriate clip spacing and attachment.

D. Verify that installed work of other trades that such work is complete to a point where the roofing system installation may commence.

E. Verify that roof openings, curbs, pipes, sleeves, ducts, vents, and other penetrations through roof substrate are complete and properly located.

F. In event of discrepancy, notify Owner in writing; do not proceed with installation until discrepancies have been resolved.

3.03 INSULATION INSTALLATION

A. Install in accordance with all requirements and recommendations of insulation and metal roofing manufacturers.

3.04 COVER BOARD INSTALLATION

3.05 UNDERLAYMENT INSTALLATION

A. Install underlayment in accordance with manufacturer's instructions.

B. Install self-adhered underlayment over entire roofing surface.

3.06 ROOF PANEL INSTALLATION

A. Install the metal roof panel system in accordance with the manufacturer’s instructions, installation drawings, and approved shop drawings, so that it is weathertight and allows for thermal movement.

B. Locate space and fasten all clips in accordance with roof panel manufacturer’s recommendations. For required fasteners, use proper torque settings to obtain controlled uniform compression for a positive seal without rupturing the sealing washers.

C. Panels must be locked in the field by a mechanical seamer. Mechanical seamer is required to be certified with manufacturer to deliver a watertight warrantied system.

D. Do not place utility penetrations through the panel seams.

E. Do not allow panels or trim to come into contact with dissimilar materials (i.e. copper, lead, graphite, treated lumber, mortar, etc). Protect from water run-off from these materials.

F. Perform field cutting of panels and related sheet metal components by means of hand or electric shears. At no time shall a hot/friction saw be used.

G. Remove protective film immediately after installation.

3.07 FLASHING AND ACCESSORIES INSTALLATION

A. Install flashings, including laps, splices, joints, bonding, adhesion, and attachment, as required by roof panel manufacturer's recommendations and details.

B. Install metal trim, accessories, and edgings in locations indicated on the drawings.
   1. Follow roofing manufacturer's instructions.
   2. Remove protective plastic surface film immediately before installation.

C. Flashing at Walls, Curbs, and Other Vertical and Sloped Surfaces: Install weathertight flashing at all walls, curbs, parapets, curbs, skylights, and other vertical and sloped surfaces that the roofing system abuts to; extend flashing at least 8 inches high above system surface.

D. Flashing at Penetrations: Flash all penetrations passing through the panel; make flashing seals directly to the penetration.
   1. Pipes, Round Supports, and Similar Items: Flash with specified pre-molded pipe flashings wherever practical.
   2. Where pre-molded pipe flashings are not practical, provide flashing detail as recommended by metal panel manufacturer.

3.08 FIELD QUALITY CONTROL

A. Inspection by Manufacturer: Provide final inspection of the roofing system by a Technical Representative employed by roofing system manufacturer specifically to inspect installation for warranty purposes (i.e. not a sales person).

B. Perform all corrections necessary for issuance of warranty.

3.09 ADJUSTING AND CLEANING

A. Repair panels having minor damage.

B. Remove panels damaged beyond repair and replace with new panels to match adjacent undamaged panels.

C. Clean exposed panel surfaces promptly after installation in accordance with recommendations of panel and coating manufacturers.

D. Clean all contaminants generated by roofing work from building and surrounding areas, including adhesives, sealants, and coatings.

E. Repair or replace building components and finished surfaces damaged or defaced due to the work of this section; comply with recommendations of manufacturers of components and surfaces.

F. Remove leftover materials, trash, debris, equipment from project site and surrounding areas.

3.10 PROTECTION

A. Where construction traffic must continue over finished roof panels, provide durable protection and replace or repair damaged roofing to original condition.

END OF SECTION 076100

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1. DESCRIPTION

A. Furnish all labor, materials, tools, equipment and services necessary for and reasonably incidental to complete the joint sealer work as indicated on the drawings or specified, including but not limited to the following:

1. Clean and prepare joint surfaces
2. Sealant and backing materials
3. Sealant for all interior and exterior joints
4. Sealant around all toilet plumbing fixtures abutting floors and walls
5. Sealant between gypsum board edge trim and wall

B. Seal all joints around the following: (and or as required by drawings) Exterior:

1. Metal door frames
2. Cast-in-place concrete slabs and walls
3. Expansion and control joints
4. Roof penetration perimeter joints
5. Window perimeter joints

C. Seal all joints around the following, and/or as required by drawings:

1. Expansion and control joints
2. Metal doors frames
3. Toilet fixtures
4. Casework tops

1.2. RELATED SECTIONS

1. 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.
2. In addition to other requirements specified, upon the Owner's request uncover work to provide for inspection by the Owner of covered work, and remove samples of installed materials for testing.
3. Do not cut or alter work performed under separate contracts without the Owner's written permission.

A. Section 033000: Cast-In-Place Concrete

B. Section 042000: Unit Masonry

C. Section 076000: Sheet Metal Flashing and Trim

D. Section 081113: Hollow Metal Doors and Frames

E. Section 085113: Aluminum Windows

F. Section 088000: Glazing

G. Section 092900: Gypsum Board Systems

H. Section 096500: Resilient Flooring

I. Section 220500: Plumbing

1.3. SUBMITTALS

A. Material submittals shall be in accordance with the requirements of Section 013300. Provide all requested information below as one submittal. Otherwise, color selections may also be incorporated into submittals sealant is associated with (ie-masonry joints can be submitted with masonry submittal; window sealant along with window submittal, etc.)

B. Submit manufacturer's standard and premium color samples for selection by the Owner.

C. Submit manufacturer's surface preparation and installation instructions.

1.4. WARRANTY

A. Provide five year warranty.

B. Replace sealants which fail because of loss of cohesion or adhesion or do not cure.

PART 2 - PRODUCTS

2.1. SEALANT MATERIALS

A. Sealant: Dynatrol II, polyurethane base, multi component, chemical curing; conforming to requirements of ASTM 920-86, B for non-sag; Shore A hardness of minimum 15 and maximum 50; nonstaining and non-bleeding. Movement flexible to 50% of joint width.

B. Sealant: AC-20 acrylic latex sealant: ASTM 834, non-sag; non-oxidizing, non-staining, single component, capable of withstanding movement of up to 7.5% of joint width. Shore A hardness of maximum 60; non-bleeding.

C. Sealant: 863 silicone sanitary sealant, ASTM 92086, Class B, non-sag. formulated with fungicide.

D. Material specified above is as manufactured by Pecora Corp. The products may be substituted with equal products from Tremco, Inc., Dow Corning Corp., or General Electric Corp.

E. Color Selection: As selected by the Owner from the manufacturer’s standard range. Control Joint sealant color at exterior masonry expansion joints is to match the field color of the brick (type 1A “red” brick), not the mortar.

2.2. ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Filler: ASTM D1056; round, closed cell polyethylene or expanded rubber foam rod; oversized 30% to 50%.

D. Bond Breaker: Pressure-sensitive tape recommended by sealant manufacturer to suit application.

PART 3 - EXECUTION

3.1. INSPECTION

A. Verify joint dimensions, physical and environmental conditions are acceptable to receive work of this section.

B. Beginning of installation means acceptance of existing conditions.

3.2. PREPARATION

A. Clean, prepare and size joints in accordance with manufacturer's instructions. Remove any loose materials and other foreign matter which might impair adhesion of sealant.

B. Verify that joint shaping materials and release tapes are compatible with sealant.

C. Examine joint dimensions and size materials to achieve required width/depth ratios.

D. Use joint filler to achieve required joint depths at all joints to allow sealants to perform properly.

E. Use bond breaker where required.

3.3. INSTALLATION

A. Perform work in accordance with ASTM C804 for solvent release and C790 for latex base sealants.

B. Install sealant in accordance with manufacturer's instructions.

C. Apply sealant within recommended temperature ranges. Consult manufacturer when sealant cannot be applied within recommended temperature ranges.

D. Tool joints concave.

E. Joints: Free of air pockets, foreign embedded matter, ridges and sags

3.4. SCHEDULE

A. Multi-Component Polyurethane Sealant: Exterior joints in masonry and exterior openings joints between metal and masonry and at all intersections between interior slabs/wall joints.

B. Acrylic Latex Sealant

1. Interior joints
2. Where gypsum board edge trim abuts concrete masonry units.
3. Where new concrete masonry unit partitions abut existing partitions, caulk vertical joint where partitions abut.

C. Silicone Sanitary Sealant: Ceramic tile and toilet plumbing fixtures

D. Clean silicone sealant around entire perimeter of mirrors.

E. Provide sealant at base of gypsum board prior to installation of rubber base.

END OF SECTION

SECTION 081113 - 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 Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Standard and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 01 Section "General Conditions".
2. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
3. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
4. Division 08 Section "Door Hardware".
5. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.

14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.6 COORDINATION

A. Coordinate installation of anchorages 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.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

1. CECO Door Products (CE).
2. Curries Company (CU).
3. Pioneer Industries (PI).

2.2 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.

2.3 HOLLOW METAL DOORS

A. General: 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. 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. Design: Flush panel.
2. Core Construction: Manufacturer's standard 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.).
3. 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.
4. 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.
5. 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.

6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. 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. Design: Flush panel.
2. 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.

3. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
4. 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.
5. 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.
6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Manufacturers Basis of Design:

1. Curries Company (CU) - Polystyrene Core - 707 Series.
2. Curries Company (CU) - Steel-Stiffened - 747 Series.

2.4 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. 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.

C. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.
3. Manufacturers Basis of Design:

    a. Curries Company (CU) - Thermal Break TQ Series.

D. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.

3. Manufacturers Basis of Design:

   a. Curries Company (CU) - M Series.

E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 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.

2.6 LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator’s shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.7 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.8 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. 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.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

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.

2.9 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. General Contractor to 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.

E. Verify tolerances against manufacturers installations instructions for tornado and hurricane storm shelter openings.

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 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.

3.5 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

END OF SECTION 081113

SECTION 08 33 13 – OVERHEAD COILING COUNTER DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. **Section Includes:** manual rolling counter doors

B. **Related Sections:**
1. Division 09 Sections: Interior Painting and Exterior Painting

1.2 **DESIGN REQUIREMENTS**
1. **Wind Loading:**
a. Supply doors to withstand wind load indicated in the structural drawings.

2. Size
a. Refer to floor plan and elevation for size; coordinate with rough masonry opening and counter.

1.3 SUBMITTALS

A. **Reference Division 01;** submit the following items:
1. **Product Data**
2. **Shop Drawings:** Include special conditions not detailed in Product Data. Show interface with adjacent work.
3. **Quality Assurance/Control Submittals:**
a. Provide manufacturer ISO 9001:2015 registration
b. Provide manufacturer and installer qualifications - see below
c. Provide manufacturer's installation instructions
4. **Closeout Submittals:**
a. Operation and Maintenance Manual
b. Certificate stating that installed materials comply with this specification

1.3 QUALITY ASSURANCE

A. **Qualifications:**
1. **Manufacturer Qualifications:** ISO 9001:2015 registered and a minimum of five years experience in producing counter doors of the type specified
2. **Installer Qualifications:** Manufacturer’s approval

1.4 DELIVERY STORAGE AND HANDLING

A. Reference Division 01
B. Follow manufacturer’s instructions.

1.5 WARRANTY

A. **Standard Warranty:** Two years from date of shipment against defects in material and workmanship
B. **Maintenance:** Submit for owner’s consideration and acceptance of a maintenance service agreement for installed products

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. **Manufacturer:**
1. **Cookson (Basis of Design):** 1901 Litchfield Road, Goodyear, AZ 85338. Telephone: (800) 294-4358.
2. **Cornell**
3. **Clopay Building Products**

Substitutions: in accordance with Division 01

2.2 PRODUCT INFORMATION

A. **Model:** ESC30

2.3 MATERIALS

A. **Curtain:**
1. **Slat Configuration:**
a. **Galvanized Steel with Finish as Described Below:** No. 1F, interlocked flat-faced slats, 1-1/2 inches (38 mm) high by 1/2 inch (13 mm) deep, minimum 22 gauge ASTM A 653, Commercial Quality, galvanized steel with extruded tubular aluminum bottom bar with continuous lift handle and vinyl astragal. Gray PVC backer slat.
b. **Insulation:** 3/8 inch (9.5 mm) open cell melamine
c. **Total Slat Thickness:** .545 inch (13.8 mm)
d. **Flame Spread Index** of 15 and a **Smoke Developed Index** of 450 as tested per ASTM E84
e. **R-value:** 2.0
f. U-Factor: .88
g. **STC Rating:** Up to 26 for the entire assembly, as tested per ASTM E90 and based on testing a complete, operable assembly

2. **Finish:**
a. **GalvaNex™ Coating System (Stock Colors):**
1) **GalvaNex™** - ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding baked-on base coat and **gray** baked-on polyester enamel finish coat

B. **Endlocks:**
Fabricate interlocking slat sections stamped steel endlocks riveted to ends of alternate slats

C. **Guides:**
1. **Fabrication:**
a. **Aluminum:** Heavy duty extruded aluminum sections with snap-on cover to conceal fasteners. Provide polypropylene pile runners on both sides of curtain to eliminate metal to metal contact between guides and curtain.

2. **Finish:**
a. **Aluminum:** [Clear anodized]

D. **Shaft Assembly:**

1. **Tube Motor Shaft Assembly:**
   a. **Barrel:** Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot (2.5 mm per meter) of width

E. **Brackets:**
Fabricate from reinforced steel plate with bearings at rotating support points to support counterbalance shaft assembly and form end closures
1. **Finish:**
   a. **Standard (Stock Colors):** Zirconium treatment followed by a **gray** baked-on polyester powder coat; minimum 2.5 mils (0.065 mm) cured film thickness

F. **Hood:**
Minimum 24 gauge galvanized steel with reinforced top and bottom edges. Provide minimum 1/4 inch (6.35 mm) steel intermediate support brackets.
1. **Finish:**
   a. **GalvaNex™ Coating System (Stock Colors):**
      1) ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding baked-on base coat and **gray** baked-on polyester enamel finish coat

2.4 OPERATION

A. **Manual Operation:**
1. **Crank Hoist:** Crank hoist operator including crank gear box, steel crank drive shaft and geared reduction unit. Fabricate gear box to completely enclose operating mechanism and be oil-tight.

2.5 ACCESSORIES

A. **Locking:**
1. **Padlockable slide bolt:** Padlockable slide bolt on coil side of bottom bar at each jamb extending into slots in guides. Provide interlock switches on motor operated units.

B. **Countertop:**
1. **Stainless steel 14 gauge type 304 #4 finish:** Coordinate shape, size, and configuration of countertop with the drawings.

C. **Operator [and Bracket Mechanism] Cover:**
1. Minimum 24 gauge galvanized steel]
2. All exposed moving operator components lower than 8 feet above floor level that create possible pinch points are required to be covered per UL 325.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates upon which work will be installed and verify conditions are in accordance with approved shop drawings
B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates
C. Commencement of work by installer is acceptance of substrate

3.2 INSTALLATION

A. Install door and operating equipment with necessary hardware, anchors, inserts, hangers and supports
B. Follow manufacturer's installation instructions

3.3 ADJUSTING

A. Following completion of installation, including related work by others, lubricate, test, and adjust doors for ease of operation, free from warp, twist, or distortion

3.4 CLEANING

A. Clean surfaces soiled by work as recommended by manufacturer
B. Remove surplus materials and debris from the site

3.5 DEMONSTRATION

A. Demonstrate proper operation to Owner's Representative
B. Instruct Owner's Representative in maintenance procedures

END OF SECTION

SECTION 087100 - DOOR HARDWARE

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 commercial door hardware for the following:

1. Swinging doors.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

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. 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.

C. 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.

D. 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.

E. 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. 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.

F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

G. 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.

H. 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), and Contractor(s) to review proper methods and the 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

I. At completion of installation, provide written documentation that components were applied according 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 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. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 BUTT HINGES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

   a. Two Hinges: For doors with heights up to 60 inches.
   b. Three Hinges: For doors with heights 61 to 90 inches.
   c. Four Hinges: For doors with heights 91 to 120 inches.
   d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

   a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
   b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

   a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
   b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

   a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

    a. Hager Companies (HA) - BB Series, 5-knuckle.
    b. Lawrence Brothers (LA) - 5 knuckle.
    c. McKinney Products(MK) - TA/T4A Series, 5-knuckle.

2.3 CONTINUOUS HINGES

A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:.

    a. Hager Companies (HA).
    b. Pemko Products (PE).
    c. Select Hinges (SL).

2.4 DOOR OPERATING TRIM

A. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
3. Manufacturers:

    a. Hiawatha, Inc. (HI).
    b. Rockwood Products (RO).
    c. Trimco (TC).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

1. Manufacturers:

    a. Corbin Russwin (RU).
    b. No Substitution.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Tubular deadlocks and other auxiliary locks.

4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
5. Keyway: Match Facility Standard.

C. Large Format Interchangeable Cores: Provide removable cores (LFIC) as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.

D. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. Existing System: Field verify and key cylinders to match Owner's Corbin Russwin existing system.

E. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Three (3) each.
2. Master Keys (per Master Key Level/Group): Five (5) each.
3. Construction Keys: Ten (10) each.
4. Construction Control Keys: Two (2) each.
5. Permanent Control Keys: Two (2) each.

F. Construction Keying: Provide temporary keyed brass construction cores.

G. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 KEY CONTROL

A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers:

a. Lund Equipment (LU).
b. MMF Industries (MM).
c. Telkee (TK).

2.7 MORTISE LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:

    a. Corbin Russwin (RU) - ML2000 Series.
    b. To Match Existing.

2.8 AUXILIARY LOCKS

A. Cylindrical Deadlocks: ANSI/BHMA A156.36 Grade 1 Certified Products Directory (CPD) listed deadlocks to fit standard ANSI 161 preparation. Provide tapered collars to resist vandalism and 1" throw solid steel bolt with hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other locksets.

1. Manufacturers:

    a. Corbin Russwin (RU) - DL3000 Series.
    b. To Match Existing.

2.9 LOCK AND LATCH STRIKES

A. 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. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Auxiliary Deadlocks: BHMA A156.36.

2.10 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.
2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.
4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Rail Sizing: Provide exit device rails factory sized for proper door width application.
8. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:

    a. Corbin Russwin (RU) - ED5000 Series.
    b. Von Duprin (VD) - 98XP Series.

C. Steel Removable Mullions: ANSI/BHMA A156.3 steel removable mullions with options for fire rating, locking, through-wire electrification and hurricane compliance as specified.

1. Manufacturers:

    a. Same as exit device manufacturer.

2.11 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power

adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard..

1. Manufacturers:

    a. Corbin Russwin (RU) - DC6000 Series.
    b. LCN Closers (LC) - 4040 Series.
    c. Norton Door Controls (NO) - 7500 Series.

2.12 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:

    a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:

    a. Hiawatha, Inc. (HI).
    b. Rockwood Products (RO).
    c. Trimco (TC).

2.13 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

a. Hiawatha, Inc. (HI).
b. Rockwood Products (RO).
c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

a. Rixson (RF).
b. Rockwood Products (RO).
c. Sargent Manufacturing (SA).

2.14 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that 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 perimeter gasketing at all smoke labeled openings.

C. 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-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. National Guard Products (NG).
2. Pemko Products (PE).
3. Reese Enterprises, Inc. (RE).

2.15 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.16 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. 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."
2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and 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.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 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.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

Set: 1 – Exterior Concessions

Doors: C100A, C100B

1	Continuous Hinge	CFM83HD1		PE
1	Storeroom Lockset	ML2057 PSA x temporary core x CMK	626C	RU
1	Permanent Core	CR8000 x XX keyway x 6 pin x MK	626	RU
1	Latch Protector	321	US32D	RO
1	Closer	DC6210 A13 x M54	689	RU
1	Armor Plate	K1050 30" x 2" LDW 4BE CSK	US32D	RO
1	Overhead Holder	9-X26 x 90 deg	652	RF
1	Threshold	1715 A x DOW x MS & ES25		PE
1	Gasketing (Set)	S88 BL x DOW x DOH		PE
1	Door Bottom Seal	345 AV x DOW		PE
1	Drip Strip	346 C x DOW + 4"		PE
1	Viewer	622	DCRM	RO

Set: 2 – Exterior Toilet

Doors: C101

1	Continuous Hinge	CFM83HD1		PE
1	Privacy Set & Indicator	ML2060 PSA x EMB x V21	626C	RU
1	Classroom Deadlock	DL3217 x temporary core x CMK	626	RU
1	Closer	DC6210 A13 x M54	689	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
1	Overhead Stop	9-X36 x 90 deg	652	RF
1	Threshold	1715 A x DOW x MS & ES25		PE
1	Gasketing (Set)	S88 BL x DOW x DOH		PE
1	Door Bottom Seal	345 AV x DOW		PE
1	Drip Strip	346 C x DOW + 4"		PE

Set: 3 – Storage

Doors: C102

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Storeroom Lockset	ML2057 PSA x temporary core x CMK	626C	RU
1	Permanent Core	CR8000 x XX keyway x 6 pin x MK	626	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
1	Wall Stop	406	US32D	RO
3	Silencer	608-RKW		RO

Set: 3.1 – Custodian

Doors: C105

3	Hinge	TA2714 4-1/2" x 4-1/2" NRP	US26D	MK
1	Storeroom Lockset	ML2057 PSA x temporary core x CMK	626C	RU
1	Permanent Core	CR8000 x XX keyway x 6 pin x MK	626	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
1	Mop Plate	K1050 4" x 1" LDW 4BE CSK	US32D	RO
1	Overhead Stop	9-X36 x 90 deg	652	RF
3	Silencer	608-RKW		RO

Set: 4 – Exterior Group Toilet

Doors: C104, C106

1	Continuous Hinge	CFM83HD1		PE
1	Classroom Deadlock	DL3217 x temporary core x CMK	626	RU
1	Push Plate	70C 4 x 16	US32D-MS	RO
1	Pull Plate	110 x 70C 4 x 16	US32D-MS	RO
1	Closer	DC6210 A13 x M54	689	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
1	Overhead Stop	9-X36 x 90 deg	652	RF
1	Threshold	1715 A x DOW x MS & ES25		PE
1	Gasketing (Set)	S88 BL x DOW x DOH		PE
1	Door Bottom Seal	345 AV x DOW		PE
1	Drip Strip	346 C x DOW + 4"		PE

Set: 5 – Exterior Team Room

Doors: ***C107***

2	Continuous Hinge	CFM83HD1		PE
1	Exit Device	ED5200 x VT957ET x temporary core x M52 x M110 x M54 x CMK	630C	RU
1	Exit Device	ED5200 x VT950ET x temporary core x M52 x M110 x M54 x CMK	630C	RU
1	Removable Mullion	CR910KM x 120" x temporary core x CMK		RU
	(Removable mullion to be cut to size in the field)			
4	Permanent Core	CR8000 x XX keyway x 6 pin x MK	626	RU
2	Closer	DC6210 A13 x M54	689	RU
2	Armor Plate	K1050 30" x 2" LDW 4BE CSK	US32D	RO

2	Overhead Stop	9-X36 x 90 deg	652	RF
1	Threshold	1715 A x DOW x MS & ES25		PE
	(Threshold to be notched for removable mullion in the field)			
1	Gasketing (Set)	S88 BL x DOW x DOH		PE
1	Mullion Door Seal	5110 BL x DOH		PE
2	Door Bottom Seal	345 AV x DOW		PE
1	Drip Strip	346 C x DOW + 4"		PE

This opening is part of Alternate #1

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1. DESCRIPTION

A. Furnish all labor, materials, tools, equipment and services necessary for and reasonably incidental to complete the glass and glazing work as indicated on the drawings or specified.

1.2. RELATED SECTIONS

1. 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.

2. In addition to other requirements specified, upon the Owner's request uncover work to provide for inspection by the Owner of covered work, and remove samples of installed materials for testing.

3. Do not cut or alter work performed under separate contracts without the Owner's written permission.

A. Section 081113: Hollow Metal Doors And Frames

B. Section 079200: Joint Sealers

1.3. DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. ASTM C 1036 also includes traditional thickness designations in IP units, but the actual thickness is based on the equivalent IP designation in millimeters.

C. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

D. IBC: International Building Code.

E. Interspace: Space between lites of an insulating-glass unit.

1.4. COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5. QUALITY ASSURANCE

A. Conform to Flat Glass Marketing Association (FGMA) Glazing Manual, latest edition.

1.6. SUBMITTALS

A. Shop drawing and material submittals shall be in accordance with the requirements of Section 013000.

B. Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.

C. Provide data on glazing sealants. Identify colors available.

D. Submit sealed glass unit manufacturer's certificate indicating units meet or exceed specified requirements.

1.7. WARRANTY

A. Provide ten year manufacturer's warranty for insulating glass.

B. Warranty: Include coverage of sealed glass units from seal failure, interpane dusting or misting, and replacement of same.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. PPG Industries, Inc. (Basis of Design for Aluminum Curtain Wall Systems and Aluminum Storefront Windows)

B. Pittsburgh Glass

C. Pilkington Group

D. Guardian

E. Or approved equal

2.3 GLASS MATERIALS

A. Insulated (Vision Clear) Glass Units for Exterior Use: Basis of Design-Solarban 60 by PPG Industries.

Clear Glass: Double pane insulated units, total 1” thickness, comprised of: tempered ¼” thick, tinted glass outer pane; Solarban 60 Low-E coating on #2 surface; ½” insulated air space; and ¼” thick laminated or tempered (contractor’s option) safety glazing inner pane (comprised of 1/8” clear glass; 0.060” Polyvinyl Butyral (PVB) Sheet; 1/8” clear glass).

a. Use at all exterior glazing applications, unless noted otherwise.

b. Use also at all interior aluminum doors and frames. Omit Low-E coating on interior glass.

c. Safety Category: II Per CPSC 16

d. Fabricated in Autoclave with heat and pressure free of foreign substances and air pockets.

2. Glazing Performance:

a. Maximum U-factor (U-value): 0.38

b. Maximum Solar Heat Gain Coefficient (SHGC): 0.40

2.4 GLAZING ACCESSORIES

A. Accessories: Types as required by manufacturer of doors and frames or as required by manufacturer of glass.

B. Safety Protection: At all exterior doors and assemblies containing doors, provide 3M Ultra S800 Maximum Life Safety Protection or approved equal at all glazing within 7'-0" of the finished floor elevation. Provide silicone edge protection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification and Conditions:

1. Verify that site conditions are acceptable for installation of the glass.
2. Verify openings for glazing are correctly sized and within tolerance.
3. Verify that a functioning weep system is present.
4. Verify that the minimum required face and edge clearances are being followed.
5. Do not proceed with glazing until unsatisfactory conditions have been corrected.

B. Beginning of installation means acceptance of substrate.

3.2 PREPARATION

A. Handle and store product according to manufacturers' recommendations.

B. Clean contact surfaces with solvent and wipe dry.

C. Seal porous glazing channels or recesses.

D. Prime surfaces scheduled to receive sealant.

E. Surface Preparation:

1. Clean and prepare glazing channels and other framing members to receive glass.
2. Remove coatings and other harmful materials that will prevent glass and glazing installation required to comply with performance criteria specified.

3.3 INSTALLATION

A. Install products using the recommendations of manufacturers of glass, sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those in the "GANA Glazing Manual".

B. Verify that Insulating Glass (IG) Unit secondary seal is compatible with glazing sealants.

C. Install glass in prepared glazing channels and other framing members.

D. Install setting blocks in rabbets as recommended by referenced glazing standards in GANA Glazing Manual and IGMA Glazing Guidelines.

E. Provide bite on glass, minimum edge and face clearances and glazing material tolerances recommended by GANA Glazing Manual.

F. Provide weep system as recommended by GANA Glazing Manual.

G. Set glass lites in each series with uniform pattern, draw, bow and similar characteristics.

H. Distribute the weight of the glass unit along the edge rather than at the corner.

I. Comply with manufacturer's and referenced industry recommendations on expansion joints and anchors, accommodating thermal movement, glass openings, use of setting blocks, edge, face and bite clearances, use of glass spacers, edge blocks and installation of weep systems.

J. Protect glass from edge damage during handling and installation.

K. Prevent glass from contact with contaminating substances that result from construction operations, such as weld spatter, fireproofing or plaster.

L. Remove and replace glass that is broken, chipped, cracked or damaged in any way.

3.4 CLEANING AND PROTECTION

A. After installation, mark pane with an "X" by using plastic tape or removable paste and remove nonpermanent labels and clean surfaces.

B. Remove glazing materials from finish surfaces.

C. Protect glass from contact with contaminating substances resulting from construction operations. 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.

1. If despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

D. Remove and replace glass that is damaged during construction period.

E. Wash glass on both exposed surfaces 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.

F. Do not use scrapers or other metal tools to clean glass.

END OF SECTION

SECTION 089000 - LOUVERS AND VENTS

PART 1 - GENERAL

1. SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum louvers.
2. Wall vents (brick vents).

B. See Division 22 & 23 Sections for louvers that are a part of mechanical equipment.

C. Refer to mechanical drawings and architectural elevations for sizes and locations of louvers. Note that louver locations will vary between base bid and alternates #1 and #2.

2. PERFORMANCE REQUIREMENTS

A. Design: Design louvers, including comprehensive engineering analysis by a qualified engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors.

1. Wind Loads: Determine loads based on a uniform pressure of 30 lb./sq. ft. (1435 Pa), acting inward or outward.

C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

3. SUBMITTALS

A. Product Data: For each type of product indicated. Provide one submittal for all information requested in this Section.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

C. Submittal: For louvers indicated to comply with structural performance requirements and design criteria indicated.

D. Product Test Reports: Based on tests performed according to AMCA 500-L.

PART 2 - PRODUCTS

1. MATERIALS

A. Aluminum Extrusions: ASTM B 221M, Alloy 6063-T5.

B. Aluminum Sheet: ASTM B 209M, Alloy 3003 with temper as required for forming.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.

2. FABRICATION, GENERAL

A. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

B. Join frame members to each other and to fixed louver blades with fillet welds concealed from view welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

3. FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Non-drainable Blade Louver :

1. Basis-of-Design Product: Architectural Louvers; Model E4JS. Subject to compliance with requirements, provide the specified product or comparable product by one of the following:
   a. Manufacturers of equivalent products submitted and approved in accordance with Section 012513 - Product Substitution Procedures.

2. Louver Depth: 4 inches (100 mm)
3. Blade Profile: Plain blade without center baffle.
4. Frame and Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm).
5. Louver Performance Ratings:

   a. Free Area: Not less than 8.06 sq. ft. (0.75 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
   b. Point of Beginning Water Penetration: Not less than 888 fpm (4.5 m/s).
   c. Air Performance: Not more than 0.13-inch wg (32-Pa) static pressure drop at 800 fpm (4.6 m/s) free-area velocity.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

4. LOUVER SCREENS

A. General: Provide screen at each exterior louver.

B. Louver Screen Frames: Same kind and form of metal as indicated for louver to which screens are attached.

C. Louver Screening: Same kind of metal as indicated for louver.

1. Insect Screening: Aluminum, 16 x 18 square mesh, 0.011-inch wire.
2. Bird Screening: Flattened, expanded aluminum, 3/4 by 0.050 inch (19 by 1.27 mm) thick.

5. ALUMINUM FINISHES

A. High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: **Sherwin-Williams 6126 Navajo White** or custom mix to match.

6. MOCK UPS

A. As indicated in location to be determined at Pre-installation conference.

B. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless the Owner specifically approves such deviations in writing.

C. Approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

PART 3 - EXECUTION

1. INSTALLATION

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather-tight connection.

C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory and refinish entire unit or provide new units.

E. Protect galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint.

END OF SECTION 089000

SECTION 092900 - GYPSUM BOARD SYSTEMS

PART 1 - GENERAL

1.1. DESCRIPTION

A. Furnish all labor, materials, tools, equipment and services necessary for and reasonably incidental to complete the gypsum board systems work as indicated on the drawings or specified, including but not limited to the following:

1. Standard Gypsum Board
2. Exterior Gypsum Board
3. Fire-Rated Gypsum Board (Interior)
4. Water Resistant Gypsum Board
5. Taping and Joint Treatment
6. Trim
7. Fiberglass faced Gypsum Board
8. Cementitious Backer Board

1.2. RELATED SECTIONS

1. 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.
2. In addition to other requirements specified, upon the Owner's request uncover work to provide for inspection by the Owner’s of covered work,and remove samples of installed materials for testing.
3. Do not cut or alter work performed under separate contracts without the Owner's written permission.

A. Section 061000: Rough Carpentry

B. Section 072100: Thermal Insulation

C. Sections 099113 and 099123: Painting

1.3. QUALITY ASSURANCE

A. Perform gypsum board systems work in accordance with recommendations of ASTM C754 and GA 216 unless otherwise specified in this section.

1.4. SUBMITTALS

A. Material submittals and catalog cuts shall be in accordance with the requirements of Section 013300. Provide all information requested below in one submittal. Incomplete submittals will be returned not reviewed.

B. Product data for the items indicated below.

PART 2 - PRODUCTS

2.1. GYPSUM BOARD

A. Acceptable Manufacturers:

1. United States Gypsum Co. (USG)
2. National Gypsum Co. (Gold Bond)

B. Provide materials in accordance with recommendations of GA 216.

C. Unless noted otherwise; All gypsum wall board is to be high impact; 5/8" thick; unless noted otherwise, maximum permissible length; ends square cut, tapered edges

D. Exterior Gypsum Board (Exterior Soffits): ASTM C-1396, regular type 5/8" thick, standard edges

E. Mold/Moisture Resistant Gypsum Board: ASTM C-630, 5/8” thick, ends square cut, tapered edges; provide mold/moisture resistant gypsum board in wet spaces (Concessions, Restrooms, Custodial).

2.2 CEMENTITIOUS BACKER UNITS

A. Provide cementitious backer units complying with ANSI A118.9, 5/8” thick, in maximum lengths available to minimize end to end butt joints. Provide at drywall partitions receiving ceramic tile.

Products: Subject to compliance with requirements, provide one of the following products:

The Original Wonderboard; Custom Building Products.

Wonderboard Multi+Board; Custom Building Products.

DomCrete Cementitious Tile-Backer Board; Domtar Gypsum.

Util-A-Crete Concrete Backer Board; FinPan, Inc.

DUROCK Cement Board; United States Gypsum Co.

2.3 IMPACT RESISTANT GYPSUM BOARD

A. ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M

1. Core: 5/8 inch or as indicated on drawings.
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 3 requirements.
5. Hard-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
6. Long Edges: Tapered.
7. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 GYPSUM BOARD ACCESSORIES

A. The following products and manufacturers may be substituted with equal products from any of the acceptable manufacturers listed above.

B. Provide gypsum board accessories in accordance with GA 216.

C. Metal Edge Trim (casing bead): Galvanized, USG No. 200B and 200A

D. Soffit Vent: Superior Model No. SDW012V212A, white painted aluminum, as manufactured by Delta Star, Inc. Soffit Vent locations are indicated on drawings.

E. Column Collar: Fry Column Collar, size as required for columns indicated on the drawings, as manufactured by Fry Reglet Corp., with a white factory-finish for collar and PVC spacer. Furnish complete with all installation accessories.

F. Reinforcing Tape: USG Perf-A-Tape

G. Joint Compound (for Standard Fire-Rated and High Impact Gypsum Board): USG Ready Mixed All Purpose Joint Compound

H. Joint Compound (for Exterior Gypsum Board): USG 90 Setting-Type Joint Compound

I. Expansion Joints: USG 093

J. Drywall Adhesives: USG Durabond

PART 3 - EXECUTION

3.1. GYPSUM BOARD INSTALLATION

A. Install all gypsum board and related products in accordance with all manufacturer requirements and recommendations.

B. Install gypsum board in accordance with recommendations of GA 216.

C. Erect single layer standard gypsum board in direction most practical and economical, with ends and edges occurring over firm bearing.

1. Install exterior soffits with cadmium plated screws.

D. Use screws when fastening gypsum board to wood or metal furring or framing.

1. Wood substrate, Type W

E. Place expansion joints in soffits as required. Center joints in both directions.

F. Place corner beads at external corners. Use longest practical lengths. Place edge trim where gypsum board abuts dissimilar materials. Allow 1/8" space between face of edge trim and dissimilar material for caulking.

G. Tape, fill and sand exposed joints, edges, corners, openings and fixings, to produce a surface ready to receive surface finishes. Feather coats onto adjoining surfaces so that camber is maximum 1/16". Finishing of taping is not required at concealed surfaces.

H. Remove and re-do defective work.

I. Gypsum board to be held off floor ½”.

3.2. ACOUSTICAL INSTALLATION

A. Coordinate installation of sound attenuation insulation, specified in another section of these specifications, with the installation of the gypsum board.

B. Place insulation between studs in accordance with manufacturer’s instructions, between studs in locations as indicated on the drawings.

END OF SECTION 092900

SECTION 093000 CERAMIC TILE

PART 1 - GENERAL

1.1. DESCRIPTION

A. Furnish all labor, materials, tools, equipment and services necessary for and reasonably incidental to complete the ceramic, porcelain, and quarry tile work as indicated on the drawings or specified, including the following:

1. Ceramic Tile
2. Marble Thresholds
3. Mortar and organic adhesives and grout for setting all tile and thresholds

1.2. RELATED SECTIONS

1. 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.
2. In addition to other requirements specified, upon the Owner's request uncover work to provide for inspection by the Owner of covered work, and remove samples of installed materials for testing.
3. DO NOT CUT OR ALTER WORK PERFORMED UNDER SEPARATE CONTRACTS WITHOUT THE OWNER’S WRITTEN PERMISSION.

A. Section 033000: Cast-In-Place Concrete

B. Section 042000: Unit Masonry

C. Section 092900: Gypsum Board Systems

1.3. REFERENCES

A. American National Standards Institute (ANSI) Installation Specifications:
1. ANSI A108 Series – Installation Specifications.
2. ANSI A108.6 – Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy.
3. ANSI A108.10 – Installation of Grout in Tilework.
4. ANSI A108.13 – Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone.
5. ANSI A108.14 – Paper-Faced Glass Mosaic Tile.
6. ANSI A108.15 – Alternate Method: Installation of Paper-Faced Glass Mosaic Tile.
7. ANSI A108.16 – Installation of Paper-Faced, Back-Mounted, Edge-Mounted, or Clear Film Face-Mounted Glass Mosaic Tile.

B. American National Standards Institute (ANSI) Material Specifications:
1. ANSI A118 Series – Material Specifications.
2. ANSI A118.15 – Improved Modified Dry-Set Mortar.
3. ANSI A137.1 – Ceramic Tile.
4. ANSI A137.2 – Glass Tile.

C. Green Squared American National Standards Institute (ANSI) Material Specifications:

1. ANSI A138.1 – Sustainable Tiles, Glass Tiles, and Tile Installation Materials – Version 2.

D. ASTM International (ASTM):
1. ASTM A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
2. ASTM C109/C109M – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars. (Using 2-inch [50-mm] Cube Specimens).
3. ASTM C627 – Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester.
4. ASTM C645 – Standard Specification for Nonstructural Steel Framing Members.

5. NSI (DSDM) – Dimension Stone Design Manual; Natural Stone Institute.

B. TCNA (HB) – Handbook for Ceramic Tile, Glass, and Stone Installation; Tile Council of North America.

C. TTMAC – Specifications Guide 09 30 00 Tile Installation Manual.

D. International Organization for Standardization (ISO):
1. ISO 13007 – Ceramic tiles – Grout and adhesives.

1.4. QUALITY ASSURANCE

A. Conform to ANSI American National Standard Specifications for the Installation of Ceramic Tile

B. Conform to ANSI Recommended Standard Specifications for Ceramic Tile - TCA 137.1

1.5. SUBMITTALS

A. Shop drawings and material submittals shall be in accordance with the requirements of Section 013300. Provide all information requested as one submittal. Incomplete submittals will be rejected and not reviewed.

B. Submit product data, specifications for tile and instructions for using adhesives and grouts.

C. Submit manufacturer's certification that tile materials supplied conform to TCA 137.1.

1.6. MAINTENANCE DATA

A. Submit maintenance data to include cleaning methods, cleaning solutions recommended, stain removal methods and polishes and waxes recommended.

1.7. PRE-INSTALLATION CONFERENCE

A. Convene one week prior to commencing work of this section.

B. Require attendance of the installation material manufacturer, tile supplier, tile installer and installers of related work. Review installation procedures and coordination required with related work.

C. Meeting agenda includes but is not limited to:
1. Tile and installation material compatibility.
2. Grouting procedure.

3. Maintenance and cleaning products and methods.
4. Surface preparation.

1.8. DELIVERY, STORAGE AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.9. ENVIRONMENTAL REQUIREMENTS

A. Comply with requirements of referenced standards and recommendations of the material manufacturers for environmental conditions before, during and after installation.

B. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and the manufacturer's printed recommendations.

C. For Interior Applications:
1. Do not begin installation until building is completely enclosed and maintaining temperature and humidity conditions consistent with "after occupancy" conditions for a minimum of 2 weeks.
2. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and the manufacturer's printed recommendations.
3. Vent temporary heaters to exterior to prevent damage to tilework from carbon dioxide build-up.
4. Maintain temperatures at not less than 50ºF (10ºC) in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standards or the manufacturer's written instructions.

PART 2 - PRODUCTS

2.1. ACCEPTABLE MANUFACTURERS

A. Daltile (Basis of Design)

B. Crossville

C. Alternate manufacturers will be considered in accordance with the requirements of Division 1.

2.2. TILE MATERIALS

A. The following tiles are as manufactured by Daltile unless noted otherwise.

1. Ceramic Mosaic Floor Tile: 2" x 2", 1/4" thick Unglazed Ceramic Mosaics, Daltile Keystones or approved equal.
1. Color Selection: Desert Gray D014

2. Ceramic Wall Tile and Cove Base: 4 ¼” x 4 ¼” x 5/16" thick. Accent, Matte, and/or Semi-Gloss as indicated in the drawings.
1. Overall ceramic tile heights indicated on bathroom elevations are minimums; exceed as required to avoid cutting tiles.
2. Colors per drawings.

3. Provide cove base where ceramic tile wall base is scheduled in the drawings. Provide Schluter strip at top and edges of tiled walls.

2.3. MORTAR MATERIALS

A. Mortar Materials: ANSI Ceramic Tile Standard A-2

2.4. ACCEPTABLE MORTAR MANUFACTURERS

A. Mapei

B. Laticrete

C. Tile Mate

D. Boiardi

2.5. ADHESIVE MATERIALS (WALL TILE AND BASE)

A. Organic Adhesive: ANSI A136.1, thin-set bond type

2.6. MORTAR BED (FLOOR TILE)

A. Mortar Bed: Latex-Portland Cement Mortar (ANSI A118.4)

2.7. GROUT TYPE

A. Grout: Cementitious type with latex additive; manufactured by Laticrete, Mapei or Boiardi, colors as selected by Architect.

2.8. MORTAR MIX AND GROUT

A. Mix and proportion pre-mix setting bed and grout materials in accordance with manufacturer's instructions.

B. All setting beds shall have latex additive at rate recommended by manufacturer.

2.9. MARBLE

A. Thresholds: Domestic, MIA Grade A, polished finish, color to be selected by Architect from the following: White, Gray, Beige, Black.

B. Thresholds shall be beveled edges in compliance with ADA guidelines as detailed on the drawings, full width of door opening and width of door frame.

2.10. WATERPROOF MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.10 and ANSI A118.12 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

A. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

1. Provide under all tile at showers, bathrooms or rooms with tile floors sloping to drains.

2. Products: Subject to compliance with requirements, provide the following:

a. Mapei; Mapelastic 400

b. Or approved equal.

2.11. SURFACE PREPARATION MATERIAL

A. Trowelable Concrete Floor Patch: High-performance, fast-setting cementitious patching compound. Can be applied at 1/16 inch to 1-1/2 inches (1.5 mm to 3.8 cm) neat and from 1-1/2 inches to 3 inches (3.8 cm to 7.5 cm) neat in areas no larger than 24 square feet (2.23 m^2).

a. Product: MAPEI, Mapecem Quickpatch or approved equal.

2.12. PRIMER

A. All-Purpose Primer: Low-odor, water-based acrylic primer for self-leveling underlayments, also suitable for a wide variety of porous and nonporous substrates.
a. Product: MAPEI, Primer T, or approved equal.

2.13. SELF-LEVELING UNDERLAYMENT

A. Quick-Setting, Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement. Applied Minimum Uniform Thickness: 1/8 inch to 1 inch (3 mm to 2.5 cm).
a. Product: MAPEI, Novoplan 2 Plus or approved equal.

2.14. SETTING MATERIAL

A. Improved Modified Dry-Set Cement Mortar, Non-Sag, for Large and Heavy Tile with High-Transfer Technology: ANSI A118.4HTE, ANSI A118.11, ANSI 118.15HTE.

a. Product: MAPEI, Keraflex Super or approved equal.

2.15. FLEXIBLE SEALANT

A. 100%-Silicone Sealant: Heavy-traffic expansion and movement joints, horizontal and vertical complying with ASTM standards; ASTM: Meets C920, Type S, Grade NS, Class 25, Use T1, T2, NT, I, M, G, A and O, and conforms to C794 adhesion properties (#23 Clear meets ASTM C920, Type S, Grade NS, Class 50, Use NT).

B. Product: MAPEI, Mapesil T or approved equal.

PART 3 - EXECUTION

3.1. INSTALLATION

A. Install ceramic tile in accordance with ANSI A108.5 and TCA F113, latest edition.

B. Install ceramic base and wall tile in accordance with ANSI A108.5 and TCA W202, latest edition, over concrete masonry units.

C. Lay floor and wall tile in pattern to align joints between floor and wall tile.

D. Provide thresholds at wall or frame openings where indicated on the drawings and in the Door and Frame Schedule.

E. Cut and fit tile tight to protrusions and vertical interruptions. Form corners and bases neatly.

F. Work tile joints uniform in width, subject to variance in tolerance allowed in tile size. Joints: Watertight, without voids, cracks, excess mortar or grout.

G. Sound tile after setting. Replace hollow sounding units.

H. Allow tile to set for a minimum of 48 hours prior to grouting. Grouting to be installed in accordance with ANSI A108.10 for floor and wall tile.

3.2. CLEANING

A. Clean all adhesive, mortar and grout from all tile surfaces. Wash tile as recommended by tile manufacturer.

3.3. PROTECTION

A. Cover tile floors with waterproof paper, with joints lapped at least 4" to protect from damage as work progresses.

B. Prohibit traffic from floor finish for 48 hours after installation.

END OF SECTION

SECTION 096500 – RESILIENT TILE FLOORING

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. Vinyl composition floor tile.
2. Rubber cove base.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

B. Mockups: If Owner requires, build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build 6’-0” x 6’-0” mockup of each type of floor tile installation with an exterior corner and an interior corner to include base and accessories. Include floor pattern where applicable.
2. Subject to compliance with requirements and approval by the Owner, 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 (10 deg C) or more than 90 deg F (32 deg C). 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 (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time 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 (13 deg C) or more than 95 deg F (35 deg C).

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.

PART 2 - PRODUCTS

2.1 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.

B. Low-Emitting Materials: Flooring system shall comply 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."

2.2 VINYL COMPOSITION FLOOR TILE

A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Standard Excelon Imperial Texture from AHF Products for standard Vinyl Composition Tile. Subject to compliance with requirements, pre-bid substitutions will be considered in accordance with Division 1.
B. Tile Standard: ASTM F 1066, Class 2, through pattern.
C. Wearing Surface: Smooth.
D. Thickness: 0.125 inch.
E. Size: 12 by 12 inches.
F. Color Options: Minimum 80
G. Colors and Patterns: Refer to finish plan.
H. Locations: Refer to finish plan and schedule.

2.3 REDUCER STRIP

A. No. RRS-XX-C, 1-1/4” x 1/8”, vinyl, as manufactured by Johnsonite.
Color Selection: Iron Mountain, or approved equal.
B. Reducer strip to be installed at edge of vinyl composition tile that abuts dissimilar materials.

2.4 BASE MATERIALS

A. Rubber Cove Base: Basis-of-Design Tarkett Johnsonite Baseworks Thermoset Rubber (Type TS), 4” high, phthalate-free, with toe, or an equal or superior product by one of the following:

1. Tarkett Johnsonite
2. Roppe Corporation
3. Allstate Flooring

B. Refer to architectural drawings and finish schedule for locations of rubber base.

C. Rubber Cove Base Color: Tarkett Iron Mountain, or approved equal.

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 floor tile manufacturer for applications indicated. Leveling and preparing all subfloor is included in the Work.

1. Subfloor filler Ardex SD-F feather finish or as approved by manufacturer.

2. Larger areas requiring leveling will use Ardex cement leveling.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

1. Adhesives shall comply with the following limits for VOC content:

a. Vinyl Composition Tile Adhesives: 50 g/L or less.
b. Rubber Floor Adhesives: 60 g/L or less.

2. Adhesives shall comply 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."

C. Floor Polish: Top Gun High Solids Floor Finish by Daycon or approved equal, on all VCT.

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 to verify acceptance by installer of the surface conditions.

1. Verify that finishes of substrates comply with tolerances (maximum 1/8” variance in 10’ or as required by manufacturer – whichever is more stringent) 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. Contractor is to install and prepare substrates with enough time to install floor tile according to floor tile manufacturer's written instructions to ensure adhesion of resilient products. If subfloor is not installed with appropriate amount of time left to achieve proper conditions and moisture requirements for floor tile installation, Contractor has the option of upgrading floor adhesive to allow for install per manufacturer’s instructions over subfloor as tested.

B. Concrete Substrates: Prepare according to ASTM F 710.

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, but not less than 5 or more than 9 pH.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:

    a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

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. Clean floor and apply trowel and float filler to leave smooth, flat surface. Prohibit traffic until filler is cured.

E. Do not install floor tiles until they are the same temperature as the 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.

F. 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 on the finish plan.

C. 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.

D. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

E. 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.

F. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor 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.

G. Adhere floor tiles to flooring 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 exposed 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 four coat(s) of floor finish, see above for product. Install in accordance with all manufacturer requirements and recommendations.

E. Cover floor tile until Substantial Completion.

END OF SECTION

SECTION 09 7700 – FIBERGLASS REINFORCED WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Prefinished polyester glass reinforced plastic sheets adhered to CMU walls.

1.2 RELATED SECTIONS

A. Division 04 Section – Unit Masonry

B. Division 09 Section – Resilient Tile Flooring

1.3 REFERENCES

A. American Society for Testing and Materials: Standard Specifications (ASTM)
1. ASTM D 256 - Izod Impact Strengths
2. ASTM D 570 - Water Absorption
3. ASTM D 638 - Tensile Strengths & Tensile Modulus
4. ASTM D 790 - Flexural Strengths & Flexural Modulus
5. ASTM D 2583- Barcol Hardness
6. ASTM D 5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.
7. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Product Data: Submit sufficient manufacturer's data to indicate compliance with these specifications, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

B. Manufacturers Material Safety Data Sheets (MSDS) for adhesives, sealants and other pertinent materials prior to their delivery to the site (available as downloads for most Marlite's products at http://www.marlite.com/tech-details.aspx or by contacting Marlite at info@marlite.com).

1.5 QUALITY ASSURANCE

A. Conform to building code requirements for interior finish for smoke and flame spread requirements as tested in accordance with:
   1. ASTM E 84 (Method of test for surface burning characteristics of building Materials)
      a. Wall Required Rating – Class C.

B. Sanitary Standards: System components and finishes to comply with:
   1. United States Department of Agriculture (USDA) / Food Safety & Inspection Services (FSIS) requirements for food preparation facilities, incidental contact.
   2. Food and Drug Administration (FDA) 2013 Food Code 6-101.11.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials factory packaged on strong pallets.

B. Store panels and trim lying flat, under cover and protected from the elements. Allow panels to acclimate to room temperature (range of 60 to 75°F) for 48 hours prior to installation.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Building are to be fully enclosed prior to installation with sufficient heat (70°) and ventilation consistent with good working conditions for finish work

B. During installation and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.
   1. Provide ventilation to disperse fumes during application of adhesive as recommended by the adhesive manufacturer.

1.8 WARRANTY

A. Furnish one-year guarantee against defects in material and workmanship.

PART 2 - PRODUCTS

2.1 BASIS-OF-DESIGN MANUFACTURER

A. Marlite; 1 Marlite Drive, Dover, OH 44622. 800-377-1221 FAX (330) 343-4668 Email: info@marlite.com www.marlite.com.
   1. Substitutions may be submitted in accordance with Division 01.

B. Product:
   1. Laminated FRP

2.2 PANELS

A. Fiberglass reinforced thermosetting polyester resin panel sheets complying with ASTM D 5319.
   1. Dimensions:
      a. Thickness – 0.090 “ (2.29mm) nominal
      b. Width - 4'-0” (1.22m) nominal
      c. Length – As required for full height wall coverage
   2. Tolerance:
      a. Length and Width: +/-1/8 “ (3.175mm)
      b. Square - Not to exceed 1/8 “ for 8 foot (2.4m) panels or 5/32 “ (3.96mm) for 10 foot (2.4m) panels

B. Properties: Resistant to rot, corrosion, staining, denting, peeling, and splintering.
   1. Flexural Strength - 1.7 x 10^4 psi per ASTM D 790.
   2. Flexural Modulus – 6.0 x 10^5 psi per ASTM D 790.
   3. Tensile Strength – 8.0 x 10^3 psi per ASTM D 638.
   4. Tensile Modulus – 9.43 x 10^5 psi per ASTM D 638.
   5. Water Absorption - 0.17% per ASTM D 570.
   6. Barcol Hardness (scratch resistance) of 30 as per ASTM D 2583.
   7. Izod Impact Strength of 7.0 ft. lbs./in ASTM D 256

C. Back Surface: Smooth. Imperfections which do not affect functional properties are not cause for rejection.

D. Front Finish:
   1. S100 S/2/S White
      a. Surface: Smooth
      b. Fire Rating: Class C or better

2.3 MOLDINGS & TRIM

A. As recommended by the manufacturer. Match panel colors.

2.4 ACCESSORIES

A. Fasteners/Adhesives: As recommended by the manufacturer for CMU substrates.

B. Sealant:
   1. Marlite Brand MS-250 Clear Silicone Sealant.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.
   1. Verify that stud spacing does not exceed 24” (61cm) on-center.

B. Repair defects prior to installation.
   1. Level wall surfaces to panel manufacturer’s requirements. Remove protrusions and fill indentations.

3.2 INSTALLATION

A. Comply with manufacturer's recommended procedures, methods, and installation sequence.

B. Coordinate installation with all masonry openings and overhead coiling doors. At openings, install FRP around CMU jambs to face of window/door jambs.

C. Cut sheets to meet supports allowing 1/8” (3 mm) clearance for every 8 foot (2.4m) of panel.
   1. Cut and drill with carbide tipped saw blades or drill bits, or cut with shears.
   2. Pre-drill fastener holes 1/8” (3mm) oversize with high speed drill bit.
      a. Space at 8” (200mm) maximum on center at perimeter, approximately 1” from panel edge.
      b. Space at in field in rows 16’ (40.64cm) on center, with fasteners spaced at 12” (30.48 cm) maximum on center.

D. Apply panels to board substrate, above base, vertically oriented with seams plumb and pattern aligned with adjoining panels.
   1. Install panels with manufacturer's recommended gap for panel field and corner joints.
      a. Adhesive trowel and application method to conform to adhesive manufacturer’s recommendations.
      b. Drive fasteners for snug fit. Do not over-tighten.

E. Apply panel moldings to all panel edges using silicone sealant providing for required clearances.
   1. All moldings must provide for a minimum 1/8 “(3mm) of panel expansion at joints and edges, to insure proper installation.
   2. Apply sealant to all moldings, channels and joints between the system and different materials to assure watertight installation.

3.3 CLEANING

A. Remove excess sealant from panels and moldings. Wipe panel down using a damp cloth and mild soap solution or cleaner.

B. Refer to manufacturer's specific cleaning recommendations Do not use abrasive cleaners.

END OF SECTION

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Steel
2. Galvanized metal

B. Related Sections include the following:

1. Division 5 Sections for shop priming of metal substrates with primers specified in this Section.
2. Section 055000 “Metal Fabrications”
3. Section 062000 “Finish Carpentry”
4. Section 081113 “Hollow Metal Doors and Frames”
5. Division 9 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.2 DEFINITIONS

A. Gloss Ranges:
1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at a 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.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification, if required by Owner: For each type of paint system and each color and gloss of topcoat indicated.
1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.4 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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity; Furnish an additional 5 percent, but not less than 2 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Sherwin-Williams Company (Basis-of-Design)
2. Duron, Inc.
3. ICI Paints.
4. McCormick Paints.
5. PPG Architectural Finishes, Inc.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors:

1. Refer to drawings for color selections.
2. Dark tints may be used on metal frames that may require more coats than that indicated on paint schedule for proper coverage.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Verify suitability of substrates.

C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

C. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

D. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

A. 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 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, comers, 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.

B. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. 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, Owner will select from standard colors and finishes available. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, covers, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
3. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
4. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
5. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.

C. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by 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.

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. If undercoats or other conditions show through topcoat, apply additional coats until cured fllm has a uniform paint finish, color, and appearance.

F. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

G. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Prefinished items include the following factory-finished components:
    a. Pre-finished windows and components.
    b. Finished perimeter systems and wall panels.
    c. Finished mechanical and electrical equipment.
    d. Light fixtures.

2. Finished metal surfaces include the following:
    a. Anodized aluminum.
    b. Stainless steel.
    c. Chromium plate.
    d. Copper and copper alloys.
    e. Bronze and brass.

3. Operating parts include moving parts of operating equipment and the following:
    a. Valve operators.

4. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Owner, and leave. in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. Waterborne High-Performance System:

a. Prime Coat: Alkyd anticorrosive metal primer.

1. Dura Clad Universal Acrylic Metal Primer; Duron, Inc.
2. 4020 PF Devflex DTM Flat InteriorlExterior Waterborne Primer & Finish; ICIPaints.
3. Interlok Interior/Exterior Rust inhibiting Acrylic Metal Primer, 06449; McCormick Paints.
4. Pitt-Tech DTM 100% Acrylic Primer 90-712; PPG Architectural Finishes, Inc.
5. ProCryl Universal Metal Primer B66W300; Sherwin-Williams Company (The).

b. Intermediate Coat: Exterior enamel matching topcoat.

1. Dura Clad DTM Acrylic Coating Gloss 95-30X; Duron, Inc.
2. 4208 QD Devflex Quick Dry Interior/Exterior Waterborne Acrylic Gloss Enamel; ICI Paints.
3. Interlok Gloss Interior/lExterior Acrylic Urethane DTM 42 Series; McCormick Paints.
4. Pitt-Tech DTM 100% Acrylic Gloss 90-374; PPG Architectural Finishes, Inc.
5. Water-Based Alkyd Industrial Enamel B53-300 Series; Sherwin-Williams Company (The).

c. Topcoat: Exterior enamel (gloss).

1. Dura Clad DTM Acrylic Coating Gloss 95-30X; Duron, Inc.
2. 4208 QD Devflex Quick Dry Interior/Exterior Waterborne Acrylic Gloss Enamel; ICI Paints.
3. Interlok Gloss Interior/Exterior Acrylic Urethane DTM 42 Series; McCormick Paints.
4. Pitt-Tech DTM 100% Acrylic Gloss 90-374; PPG Architectural Finishes, Inc.
5. Water-Based Alkyd Industrial Enamel B53-300 Series; Sherwin-Williams Company (The).

B. Galvanized-Metal Substrates:

1. Latex Over Water-Based Primer System:

a. Prime Coat: Waterborne galvanized-metal primer.

1. Dura Clad DTM Acrylic Coating Gloss 95-30X; Duron, Inc.
2. 4020 PF Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish; ICI Paints.
3. State House Exterior Acrylic Latex Primer, 06438; McCormick Paints.
4. 90-708 Series Pitt-Tech One Pack Interior/Exterior Industrial Primer; PPG Architectural Finishes, Inc.
5. DTM Acrylic PrimerlFinish B66Wl; Sherwin-Williams Company (The).

b. Intermediate Coat: Exterior latex matching topcoat.

1. Dura Clad DTM Acrylic Coating Gloss 95-30X; Duron, Inc.
2. 4208 QD Devflex Quick Dry Interior/Exterior Waterborne Acrylic Gloss Enamel; ICI Paints.

3. Interlok Gloss Interior/Exterior Acrylic Urethane DTM, 42 Series; McCormick Paints.
4. Pitt-Tech DTM 100% Acrylic Gloss 90-374; PPG Architectural Finishes, Inc.
5. DTM Acrylic Gloss Coating B66WIO0 Series; Sherwin-Williams Company (The).

c. Topcoat: Exterior latex (gloss).

1. Dura Clad DTM Acrylic Coating Gloss 95-30X; Duron, Inc.
2. 4208 QD Devflex Quick Dry Interior/Exterior Waterborne Acrylic Gloss Enamel; ICI Paints.
3. Interlok Gloss Interior/Exterior Acrylic Urethane DTM, 42 Series; McCormick Paints.
4. Pitt-Tech DTM 100% Acrylic Gloss 90-374; PPG Architectural Finishes, Inc.
5. DTM Acrybc Gloss Coating B66WI00 Series; Sherwin-Williams Company (The).

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART I - GENERAL

1.1 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the exterior of the following substrates:

1. Concrete masonry units (CMU).
2. Steel.
3. Galvanized metal.
4. Wood.
5. Gypsum board.
6. Cotton or canvas insulation covering.
7. Exposed PVC piping.

B. Related Sections include the following:

1. Division 5 Sections for shop priming of metal substrates with primers specified in this Section.
2. Section 081113 “Hollow Metal Doors And Frames”
3. Division 9 Section "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
4. Division 9 Section "Gypsum Board Systems" for surface preparation of gypsum board.

1.2 DEFINITIONS

A. Gloss Ranges:
1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at a 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.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification, if required by Owner: For each type of paint system and each color and gloss of topcoat indicated.
1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.4 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. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Owner will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
    a. Wall and Ceiling Surfaces: Provide samples of at least 25 sq. ft.
    b. Other Items: Owner will designate items or areas required.
2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on benchmark samples.
    a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Owner at no added cost.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity; Furnish an additional 5 percent, but not less than 2 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Sherwin-Williams Company (Basis-of-Design)
2. Duron, Inc.
3. ICI Paints.
4. McCormick Paints.
5. PPG Architectural Finishes, Inc.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors:

1. Refer to drawings for colors and locations.
2. Different colors may be used in the same room.
3. Colors for ceilings and trim may be different from walls, and walls may be more than one color or striped.
4. Dark tints may be used on metal frames that may require more coats than that indicated on paint schedule for proper coverage.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Masonry (Clay and CMU): 12 percent.
2. Wood: 15 percent.
3. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

C. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

F. Wood Substrates:
1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

G. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

H. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

A. 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 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, comers, 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.

B. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. 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.
    a. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, covers, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
3. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
4. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
5. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.

C. Block Fillers:

1. Apply two coats of block filler to concrete masonry block at a rate to ensure complete coverage with pores filled.
2. Perform a squeegee operation on second coat to fill all crevices and produce a smooth surface; do not remove filler material from surface with the squeegee operation.

D. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by 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.

E. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of

topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

F. 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.

G. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

H. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

I. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
   1. Mechanical Work:
      a. Uninsulated metal piping.
      b. Uninsulated plastic piping.
      c. Pipe hangers and supports.
      d. Tanks that do not have factory-applied final finishes.
      e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
      f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
      g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
   2. Electrical Work:
      a. Switchgear.
      b. Panelboards.
      c. Electrical equipment that is indicated to have a factory-primed finish for field painting.
      d. Exposed wiremold and conduit in all finished spaces to match color of wall.

J. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

   1. Prefinished items include the following factory-finished components:
      a. Architectural woodwork.
      b. Acoustical wall panels.
      c. Toilet enclosures..
      d. Unit kitchens.
      e. Finished mechanical and electrical equipment.
      f. Light fixtures.

   2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
      a. Foundation spaces.
      b. Furred areas.
      c. Ceiling plenums.
      d. Utility tunnels.
      e. Pipe spaces.
      f. Duct shafts.

3. Finished metal surfaces include the following:
   a. Anodized aluminum.
   b. Stainless steel.
   c. Chromium plate.
   d. Copper and copper alloys.
   e. Bronze and brass.

4. Operating parts include moving parts of operating equipment and the following:
   a. Valve and damper operators.
   b. Linkages.
   c. Sensing devices.
   d. Motor and fan shafts.

5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave. in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

A. CMU Substrates:

1. High-Performance Architectural Latex System: Semigloss finish:

   a. Prime Coat: Interior/exterior latex block filler.
      1. Block Filler 08-128; Duron, Inc.
      2. 4000 Blox-Fil InteriorlExterior Heavy Duty Acrylic Block Filler; ICI Paints.
      3. McCormick Interior Exterior Latex Blockfiller 01015; McCormick Paints.
      4. Speedhide 6-7 Block Filler Latex; PPG Architectural Finishes, Inc.
      5. Loxon Block Surfacer; Sherwin-Williams Company (The).

   b. Intermediate Coat: High-Performance Architectural Latex matching topcoat.
      1. 35-Series; Duron, Inc.

2. 1406 Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel; ICI Paints.
3. Tempo Interior Semi Gloss Acrylic Latex Enamel 18 Series; McCormick Paints.
4. 9-510 Series; PPG Architectnral Finishes, Inc.
5. ProClassic B31 Series; Sherwin-Williams Company (The).

c. Topcoat: High-Performance Architectural Latex (semigloss).
1. 35-Series; Duron, Inc.
2. 1406 Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel; ICI Paints.
3. Tempo Interior Semi Gloss Acrylic Latex Enamel 18 Series; McCormick Paints.
4. 9-510 Series; PPG Architectnral Finishes, Inc.
5. ProClassic B31 Series; Sherwin-Williams Company (The).

B. Spot Prime for Field Connections and Touch Up for Structural Elements:

1. Thoroughly examine structural elements for bare spots and abraded surface; spot prime for full coverage.
2. Extend spot prime minimum 6 inches beyond edge of field connections.
3. Waterborne Enamel System:
a. Prime Coat:
1. Dura Clad Universal Acrylic Metal Primer 33-105; Duron, Inc.
2. 4020 PF Devtlex DTM Flat Interior/Exterior Waterborne Primer & Finish; ICI Paints.
3. Interlok InterioriExterior Rust Inhibiting Acrylic Metal Primer 06449; McCormick Paints.
4. 90-712 Series; PPG Architectural Finishes, Inc.
5. ProCryl; Universal Primer B66W300 Series; Sherwin-Williams Company (The).

C. Steel Substrates:

1. Quick-Drying Enamel System: Shop prime.

a. Prime Coat: Quick -drying alkyd metal primer.
1. Dura Clad Universal Acrylic Metal Primer 33-105; Duron, Inc.
2. 24020 PF Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish; ICI Paints.
3. Interlok Interior/Exterior Rust Inhibiting Acrylic Metal Primer 06449; McCormick Paints.
4. 90-712 Series; PPG Architectural Finishes, Inc.
5. ProCryl Universal Primer B66W300 Series; Sherwin-Williams Company (The).

2. Water-Based Dry-Fall System:

a. Prime Coat:
1. Dura Clad Fast Dry Universal Phenolic Alkyd Primer 33-042; Duron, Inc.

2. 1280 Spraymaster Pro Uni-Grip-WB Aquacrylic Dryfall Flat Primer & Finish; ICI Paints.
3. McCormick Interior Waterborne Acrylic Dry Fall 01219; McCormick Paints.
4. 90-712 Series; PPG Architectural Finishes, Inc.
5. DTM B66WI Series; Sherwin-Williams Company (The).

b. Topcoat: Waterborne dry fall.
1. Dura Clad Latex Dry Fog 904-0005 Flat, or, 904-0000 Eggshell; Duron, Inc.
2. 1280 Spraymaster Pro Uni-Grip-WB Aquacrylic Dryfall Flat Primer & Finish; ICI Paints.
3. McCormick Interior Waterborne Acrylic Dry Fall 01219; McCormick Paints.
4. 6-71S Series; PPG Architectural Finishes, Inc.
5. B42W2 Series; Sherwin-Williams Company (The).

3. High-Performance Architectural Latex System: Semigloss finish.
a. Prime Coat - Field Applied: High-Performance Waterborne metal primer; shop prime with Quick-Drying Enamel System).
1. Dura Clad Universal Acrylic Metal Primer, 33-105; Duron, Inc.
2. 4020 PF Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish; ICI Paints.
3. Interlok Interior/Exterior Rust Inhibiting Acrylic Metal Primer 06449; McCormick Paints.
4. 90-712 Series; PPG Architectural Finishes, Inc.
5. ProCryJ Universal Primer B66W300 Series; Sherwin-Williams Company (The).

b. Intermediate Coat: High-performance architectural latex matching topcoat.
1. Dura Clad Acrylic Epoxy (single-component) Semi-gloss 901-0001; Duron, Inc.
2. 1406 Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel; ICI Paints.
3. Interlok Gloss Interior/Exterior Acrylic Urethane DTM 42 Series; McCormick Paints.
4. 9-510 Series; PPG Architectural Finishes, Inc.
5. ProMar 200 B31W2200 Series; Sherwin-Williams Company (The).

c. Topcoat: High-performance architectural latex (semigloss).
1. Dura Clad Acrylic Epoxy (single-component) Semi-gloss 901-0001; Duron, Inc.
2. 1406 Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel; ICI Paints.
3. Interlok Gloss Interior/Exterior Acrylic Urethane DTM 42 Series; McCormick Paints.
4. 9-510 Series; PPG Architectural Finishes, Inc.
5. ProMar 200 B31 W2200 Series; ShelWin-Williams Company (The).

4. Waterborne Urethane System: Handrails and railing systems, unless prefinished or otherwise indicated.
a. Prime Coat - Field Applied: (shop prime with Quick-Drying Enamel System).

1. Duron Dura Clad Universal Acrylic Metal Primer, 33-IOS (VOC 80 gIL); Duron, Inc.
2. ICI Devflex 4020 PF Direct to Metal Waterborne Primer Finish (91 VOC); ICI Paints.
3. Interlok Interior/Exterior Rust Inhibiting Acrylic Metal Primer 06449; McCormick Paints.
4. 97-680 Series; PPG Architectural Finishes, Inc.
5. S-W ProCryl Universal Primer, B66-310 Series (VOC 110 g/L); Sherwin Williams Company (The).

b. Intermediate Coat: Interior latex matching topcoat.
1. Dura Clad 950; Duron, Inc.
2. ICI 659 DIM Direct to Metal Acrylic Finish (124 VOC); ICI Paints.
3. Interlok Interior/Exterior Acrylic Urethane DTM 43 Series; McCormick Paints.
4. 95-812 Series; PPG Architectural Finishes, Inc.
5. S-W Centurion WE Urethane, B65-700 Series (VOC 66 giL); Sherwin Williams Company (The).

c. Topcoat: Interior latex (gloss).
1. Dura Clad 950; Duron, Inc.
2. ICI 659 DIM Direct to Metal Acrylic Finish (124 VOC); ICI Paints.
3. Interlok Interior/Exterior Acrylic Urethane DTM 43 Series; McCormick Paints.
4. 95-812 Series; PPG Architectural Finishes, Inc.
5. S-W Centurion WE Urethane, B65-700 Series (VOC 66 giL); Sherwin Williams Company (The).

D. Galvanized-Metal Substrates:

1. Water-Based Dry-Fall System:

a. Prime Coat: Waterborne dry fall.
1. Dura Clad Int. Dry Fog Latex Eggshell 904-000 (VOC 21 gIL); Duron, Inc.
2. 1280 Spraymaster Pro Uni-Grip-WE Aquacrylic Dryfall Flat Primer & Finish; ICI Paints.
3. Sealzit II Acrylic Primer-Sealer-Stain Blocker 06443; McCormick Paints.
4. 90-712 Series; PPG Architectural Finishes, Inc.
5. B42W2 Series; Sherwin-Williams Company (The).

b. Topcoat: Waterborne dry fall.
1. Dura Clad Int. Dry Fog Latex Eggshell 904-000 (VOC 21 gIL); Duron, Inc.
2. 1280 Spraymaster Pro Uni-Grip-WB Aquacrylic Dryfall Flat Primer & Finish; ICI Paints.
3. McCormick Interior Waterborne Acrylic Dry Fall 01219; McCormick Paints.
4. 6-715 Series; PPG Architectural Finishes, Inc.
5. B42W2 Series; Sherwin-Williams Company (The).

2. Quick-Drying Enamel System: Shop prime.

a. Prime Coat: Quick-drying alkyd metal primer.
   1. Dura Clad 55 Universal Alkyd Metal Primer; Duron, Inc.
   2. ICI Devflex 4020 PF Direct to Metal Waterborne Primer Finish; ICI Paints.
   3. McCormick Paints.
   4. 90-712 Series; PPG Architectural Finishes, Inc.
   5. ProCryl Universal Primer B66W300 Series; Sherwin-Williams Company (The).

3. High-Performance Architectural Latex System Over Waterborne Primer System: Semigloss finish.
   a. Prime Coat - Field Applied: Waterborne galvanized-metal primer; shop prime with Quick-Drying Enamel System).
      1. Dura Clad Universal Acrylic Metal Primer, 33-105; Duron, Inc.
      2. 4020 PF Devflex DIM Flat Interior/Exterior Waterorne Primer & Finish; ICI Paints.
      3. 1" Step Interior Latex Enamel Undercoat and Primer Sealer 06441; McCormick Paints.
      4. 90-712 Series; PPG Architectural Finishes, Inc.
      5. A41W21O Series; Sherwin-Williams Company (The).

   b. Intermediate Coat: Interior latex matching topcoat.
      1. Plastic Kote Interior Acrylic Semi-Gloss Enamel 122-Series; Duron, Inc.
      2. 1406 Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel; ICI Paints.
      3. Interlok Gloss Interior/Exterior Acrylic Urethane D1M 42 Series 42 Series; McCormick Paints.
      4. 9-510 Series; PPG Architectural Finishes, Inc.
      5. ProMar 200 B31 W2200 Series; Sherwin-Williams Company (The).

   c. Topcoat: Interior latex (semigloss).
      1. Plastic Kote Interior Acrylic Semi-Gloss Enamel 122-Series; Duron, Inc.
      2. 1406 Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel; ICI Paints.
      3. Interlok Gloss Interior/Exterior Acrylic Urethane DTM 42 Series 42 Series; McCormick Paints.
      4. 9-510 Series; PPG Architectural Finishes, Inc.
      5. ProMar 200 B31 W2200 Series; Sherwin-Williams Company (The).

E. Dimensional and Dressed Lumber Substrates: Including architectural woodwork.
   1. High-Performance Architectural Latex System: Semigloss finish.
      a. Prime Coat: Interior latex-based wood primer.
         1. Interior Acrylic Enamel Undercoater 04-123; Duron, Inc.
         2. 3210 Prep & Prime Gripper Multi-Purpose Water-Based Primer Sealer; ICI Paints.
         3. 1" Step Interior Latex Enamel Undercoat and Primer Sealer 06441; McCormick Paints; McCormick Paints.
         4. Speedhide Acrylic Enamel Undercoater No. 6-855; PPG Architectural Finishes, Inc.

5. PrepRite Classic Primer; Sherwin-Williams Company (The).

b. Intermediate Coat: High-performance architectural latex matching topcoat.
   1. Plastic Kote Interior Acrylic Semi-Gloss Enamel 122-Series; Duron, Inc.
   2. 1406 Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel; ICI Paints.
   3. Tempo Interior Semi-Gloss Acrylic Enamel 18 Series; McCormick Paints.
   4. Speedhide Acrylic Semi-Gloss Enamel No.6-51 0 Series; PPG Architectural Finishes, Inc.
   5. ProClassic Waterborne Interior Acrylic Semi-Gloss B31 Series; Sherwin Williams Company (The).

c. Topcoat: High-perfonnance architectural latex (semigloss).
   1. Plastic Kote Interior Acrylic Semi-Gloss Enamel I 22-Series; Duron, Inc.
   2. 1406 Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel; ICI Paints.
   3. Tempo Interior Semi-Gloss Acrylic Enamel 18 Series; McCormick Paints.
   4. Speedhide Acrylic Semi-Gloss Enamel No.6-51 0 Series; PPG Architectural Finishes, Inc.
   5. ProClassic Waterborne Interior Acrylic Semi-Gloss B3l Series; Sherwin Williams Company (The).

F. Wood Panel Substrates: Including painted plywood and back-painting millwork.

1. High-Performance Architectural Latex System: Semigloss finish.
   a. Prime Coat: Interior latex-based wood primer.
      1. Interior Acrylic Enamel Undercoater 04-123; Duron, Inc.
      2. 3210 Prep & Prime Gripper Multi-Purpose Water-Based Primer Sealer; ICI Paints.
      3. Sealzit II Acrylic Primer-Sealer-Stain Blocker 06443; McCormick Paints.
      4. 6-855 Series; PPG Architectural Finishes, Inc.
      5. PrepRite Classic Primer; Sherwin-Williams Company (The).

   b. Intermediate Coat: High-performance architectural latex matching topcoat.
      1. Acrylic System, Ultra Deluxe Int. Acrylic Latex Enamel 125-Series (VOC 130 g/L); Duron, Inc.
      2. ICI 1508 Dulux Ultra Advanced Alkyd Gloss Enamel (88 VOC); ICI Paints.
      3. Interlok Interior/Exterior Acrylic Urethane DTM 42 Series; McCormick Paints.
      4. 6-510 Series; PPG Architectural Finishes, Inc.
      5. S-W Waterbased Industrial Enamel, B53-300 Series (l40 giL); Sherwin Williams Company (The).

   c. Topcoat: High-performance architectural latex (semigloss).

1. Acrylic System, Ultra Deluxe Int. Acrylic Latex Enamel 125-Series (VOC 130 g/L); Duron, Inc.
2. ICI 1508 Dulux Ultra Advanced Alkyd Gloss Enamel (88 VOC); ICI Paints.
3. Interlok Interior/Exterior Acrylic Urethane DTM 42 Series; McCormick Paints.
4. 6-510 Series; PPG Architectural Finishes, Inc.
5. S-W Waterbased Industrial Enamel, B53-300 Series (140 g/L); Sherwin Williams Company (The).

G. Gypsum Board Substrates: 4-coat application.

1. High-Performance Architectural Latex System: Semi-gloss finish.

a. Prime Coat: Interior latex primer/sealer.
1. Acrylic Enamel Undercoater 04-123; Duron, Inc.
2. 3210 Prep & Prime Gripper Multi-Purpose Water-Based Primer Sealer; ICI Paints.
3. I" Step Latex Enamel Undercoat and Primer Sealer 06441; McCormick Paints.
4. 6-2 Series; PPG Architectural Finishes, Inc.
5. PrepRite B28W200 Series; Sherwin-Williams Company (The).

b. Intermediate Coat: High-performance architectural latex matching topcoat.
1. Plastic Kote Interior Acrylic Semi-Gloss Enamel 122-Series; Duron, Inc.
2. 1406 Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel; ICI Paints.
3. Tempo Interior Semi-Gloss Acrylic Enamel 18 Series; McCormick Paints.
4. 6-500 Series; PPG Architectural Finishes, Inc.
5. ProMar 200 B31W200 Series; Sherwin-Williams Company (The).

c. Third Coat and Topcoat: High-performance architectural latex (semi-gloss); same shade both coats.
1. Plastic Kote Interior Acrylic Semi-Gloss Enamel 122-Series; Duron, Inc.
2. 1406 Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel; ICI Paints.
3. Tempo Interior Semi-Gloss Acrylic Enamel 18 Series; McCormick Paints.
4. 6-500 Series; PPG Architectural Finishes, Inc.
5. ProMar 200 B31 W200 Series; Sherwin-Williams Company (The).

H. Cotton or Canvas Insulation-Covering Substrates: Including pipe and duct coverings.

1. High-Performance Architectural Latex System:
a. Prime Coat: Interior latex primer/sealer.
1. Interior Acrylic Enamel Undercoater_04-123; Duron, Inc.

2. 3210 Prep & Prime Gripper Multi-Purpose Water-Based Primer Sealer; ICI Paints.
3. I" Step Latex Enamel Undercoat and Primer Sealer 06441; McCormick Paints.
4. 6-SIO Series; PPG Architectural Finishes, Inc.
5. PrepRite 200 B28W200 Series; Sherwin-Williams Company (The).

b. Intermediate Coat: High-performance architectural latex matching topcoat.
   1. Plastic Kote Interior Acrylic Semi-Gloss Enamel I 22-Series; Duron, Inc.
   2. 1406 Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Finish; ICI Paints.
   3. Tempo Interior Semi-Gloss Acrylic Enamel 18 Series; McCormick Paints.
   4. 6-S10 Series; PPG Architectural Finishes, Inc.
   5. ProMar 200 Latex; Sherwin-Williams Company (The).

c. Topcoat: High-perfonnance architectural latex (semigloss).
   1. Plastic Kote Interior Acrylic Semi-Gloss Enamel I 22-Series; Duron, Inc.
   2. 1406 Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Finish; ICI Paints.
   3. Tempo Interior Semi-Gloss Acrylic Enamel 18 Series; McCormick Paints.
   4. 6-S10 Series; PPG Architectural Finishes, Inc.
   5. ProMar 200 Latex; Sherwin-Williams Company (The).

I. Exposed PVC Piping:
   1. High-Performance Architectural Latex System over bond coat:
      a. Bond Coat:
         1. American Terminator Water Based Stain KillerlPrimer, 71-218; Duron, Inc.
         2. ICI Paints.
         3. Sealzit II Acrylic Primer-Sealer-Stain Blocker 06443; McCormick Paints.
         4. Pitt-Tech DTM 100% Acrylic Primer 90-712; PPG Architectural Finishes, Inc.
         5. PrepRite Bonding Primer, BSI WSO; Sherwin-Williams Company (The).
      b. Intermediate Coat and Topcoat: Same type paint used on adjacent surfaces.

END OF SECTION

SECTION 101100 – VISUAL DISPLAY SURFACE

PART 1 - GENERAL

1.1. DESCRIPTION

A. Furnish all labor, materials, tools, equipment and services necessary for and reasonably incidental to complete the work, as indicated on the drawings or specified, including but not limited to the following:

1. Magnetic Marker Board
2. This work is part of Alternate #1

1.2. RELATED SECTIONS

1. 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.
2. In addition to other requirements specified, upon the Owner's request uncover work to provide for inspection by the Owner of covered work, and remove samples of installed materials for testing.
3. Do not cut or alter work performed under separate contracts without the Owner's written permission.

B. Section 042000 - Unit Masonry

C. Section 061000 – Rough Carpentry

D. Section 092900 - Gypsum Board Systems

E. Applicable Sections in Division 27

1.3. SUBMITTALS

A. Material submittals shall be in accordance with the requirements of Section 0133000.

1.4. GUARANTEE

A. Guarantee all workmanship and material furnished under this section for a period of one year, except as noted hereinafter.

PART 2 - PRODUCTS

2.1. ACCEPTABLE MANUFACTURERS

A. Claridge Products and Equipment, Inc.

B. Nelson Adams

C. Polyvision

2.2. MARKERBOARDS

A. Face Sheet: 24-gauge, magnetic, porcelain enamel steel, magnetic marker board, white, for use with Liquid Chalk. Face Sheet to be factory-laminated to 3/8" particle board core with foil back. Guarantee all workmanship and material furnished for a period of fifty years.

1. Refer to the drawings for location (Team Room).

2.3. TRIM

A. All trim to be aluminum snap-on applied to continuous grounds with clips. All corners of trim to be mitered and edges to be ground to prevent sharp corners.

B. Map Rail: Provide at top of each combination marker board/tack board and at top of each marker board. Furnish with each map rail, a pair of map hooks compatible with map rail and flag holder. Map rail shall be equal to Claridge No. 274.

C. Trim: All trim, including jambs and mullion dividers, shall be 1-3/4" wide, snap-on trim.

D. Marker Tray: Claridge No. 371 surface applied, complete with end closures. Furnish at all markerboards, unless noted otherwise.

PART 3 - EXECUTION

3.1. Marker board shall be installed where indicated on the drawings, in a secure manner, as recommended by the manufacturer.

1. Provide concealed fire rated (F.R.T.) blocking continuous at full board perimeter as required to secure assembly.

3.2. Any materials or surfaces damaged during installation shall be replaced at no cost to Owner.

END OF SECTION

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1. DESCRIPTION

A. Furnish all labor, materials, tools, equipment and services necessary for and reasonably incidental to complete the toilet compartment work as shown on the drawings or specified, including but not limited to the following:

1. Partitions and doors for toilet compartments
2. Attachment hardware

1.2. RELATED SECTIONS

1. 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.
2. In addition to other requirements specified, upon the Owner's request uncover work to provide for inspection by the Owner of covered work, and remove samples of installed materials for testing.
3. Do not cut or alter work performed under separate contracts without the Owner's written permission

B. Section 042000 - Unit Masonry

C. Section 093000 - Ceramic and Quarry Tile

D. Section 108000 - Toilet Accessories

1.3. SUBMITTALS

A. Shop drawings and material submittals shall be in accordance with the requirements of Section 01300.

B. Clearly indicate partition layouts, swing of doors, elevations, anchorage and mounting details, panel construction, components hardware, finishes and all relevant dimensions.

1.4. QUALITY ASSURANCE

A. Employ only installers who are thoroughly trained and skilled in the installation of polymer plastic partitions. Installer shall have successfully been in the business for a minimum of 5 years.

B. Take field measurements and submit shop drawings.

1.5. WARRANTY

A. Furnish manufacturers guarantee for a minimum of fifteen (15) years against defects in materials and workmanship and rusting of hardware, accessories or other metal items and breakage of door hinges.

PART 2 - PRODUCTS

2.1. ACCEPTABLE MANUFACTURERS

A. Scranton Products

B. Rockville Partitions, Inc.

C. Comtec Industries

D. Santana Products

2.2. TYPE

A. Provide floor supported toilet partitions, headrail braced.

2.3. MATERIALS

A. Panels, doors and pilasters for acceptable manufacturers shall be fabricated from HDPE or HDPP resin. All brackets and hardware to have an anodized bright-dip finish.
Color Selection: Scranton Products Orange Peel 'Grey' or similar

B. Pilasters shall be attached to walls with continuous aluminum single ear brackets. Panels shall be attached to walls with continuous aluminum double ear brackets and to pilasters with continuous aluminum "U" brackets. Brackets to be anchored at walls with 1-3/4" stainless steel torx fasteners and attached to panels and pilasters with stainless steel, chrome-plated theft-resistance fasteners with center pin.

C. Hardware:

1. Standard 24" inswing doors shall be equipped with two 4" Universal wrap-around chrome plated non ferrous field set or 4" bright aluminum material with heavy duty pin set in the factory. Doors to be field set, operable, and adjustable to any angle within a 240 degree arc.

2. Handicapped 36" outswing doors shall be hung on continuous spring-loaded stainless steel hinges, which shall consist of a continuous contact piano hinge 55" long. Hinge to be fully integrated with solid continuous full door height. Extruded aluminum channels designed to fully wrap around and strengthen the face edge of both pilaster and door at the hinge location. Configuration of pilaster hinge channel to provide total exterior concealment of hinge and fasteners on all gravity inswing doors. All handicapped doors shall return to the fully closed position.

3. Doors shall have concealed latch with emergency key way. Concealed latch shall have a lever handle to meet ADA requirements.

4. Handicapped 36" outswing: Door strikes shall be continuous full door height extruded aluminum channel designed to fully wrap around and strengthen the face edge of the door. Configuration of the door strike channel to provide total vision screen concealment of one

compartment interior in the closed door position and shall be identical in design and appearance with pilaster hinge channel.

5. Standard 24" inswing: Door strikes shall be surface-mounted style equipped with rubber bumper and attached to pilaster with continuous stainless steel gravity piano hinge.

6. Each door shall be equipped with a combination coat hook and bumper attached to the door and continuous stainless steel gravity piano hinge.

D. Headrail shall be formed of extruded aluminum sections of 1.188 x 1.563 aluminum with "NO-GRIP" design. Headrail shall be securely anchored at wall with a stainless steel bracket and to intervening pilasters with stainless steel, theft-resistant torx fastener with center pin.

E. Floor anchor assemblies shall be concealed by a 4" high trim cover. The trim cover shall be Die-formed Stainless Steel #304 18-B Shoe.

2.4. FABRICATION - TOILET COMPARTMENTS

A. Doors: 1" thick x 24" wide x 58" high. 36" wide door, swinging in, for handicapped compartments.

B. Panels: 1" thick x 58" high, depth as indicated on the drawings.

C. Pilasters: 1" thick x 82" high, constructed same as doors, of sizes required to suit cubicle widths and spacing.

D. Bottom of doors and panels shall be 12" above finish floor.

E. For inswing doors, all pilaster hinge locations to be factory drilled for stainless steel, chrome-plated, theft-resistant fasteners with center pin.

F. All edges of doors, panels and pilasters shall be machine smooth.

G. At bottom edge of all doors and panels, provide a 1” heat strip.

PART 3 - EXECUTION

3.1. PREPARATION

A. In stud partitions contractor shall pre-install continuous bridging between studs and blocking at all partition bracket locations.

B. Take site dimensions affecting this work.

C. Ensure correct spacing of plumbing fixtures.

D. Ensure correct location or built-in framing, anchorage and bracing, where required.

3.2. INSTALLATION

A. Install partitions, secure, plumb, level and square.

B. Leave 1/2" minimum, 1" maximum space between wall and panels and between wall and end pilasters.

C. Attach continuous panel brackets securely to walls using anchor devices compatible with type of material to which panel brackets are to be attached.

D. Attach panels and pilasters to continuous bracket with stainless steel, chrome-plated, theft-resistant torx fasteners with center pin.

E. Pilasters shall be anchored to floor with heavy 13 gauge aluminum angle. Conceal floor fastenings with trim cover.

F. Equip each door with hinges, one (1) door latch and one (1) coat hook and bumper.

G. Install inswing door strike keeper with door bumper on each pilaster in alignment with door latch.

H. Adjust and align hardware to uniform clearance at vertical edges of doors not exceeding 3/16".

I. Adjust hinges to locate doors in partial open position when unlatched (approximately 15 degrees), except that out-swing doors shall return to closed position.

J. Headrail shall be securely anchored at wall with a stainless steel bracket and to intervening pilasters with a stainless steel, theft-resistant torx fastener with center pin.

K. As continuos aluminum brackets continue above tile wainscots gaps between the bracket and finished wall surface are to be continuously blocked with HPDE

3.3. CLEANING

A. Field repair of damaged surfaces will not be permitted. Damaged, scratched or marred defective materials will be rejected and shall be replaced with new materials.

B. Remove protective maskings. Clean surfaces free of oil and imperfections.

END OF SECTION

SECTION 102800 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1. DESCRIPTION

A. Contractor to furnish all labor, materials, tools, equipment and services necessary for and reasonably incidental to complete the toilet accessories work as indicated on the drawings or specified.

B. The use of the word “toilet” does not mean to imply that accessories occur only in the toilets. It is used to imply type of accessories. Paper towel dispenser and soap dispenser are to be provided at all restroom sinks and at concession hand washing sink.

1.2. RELATED SECTIONS

1. 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.
2. In addition to other requirements specified, upon the Owner's request uncover work to provide for inspection by the Owner of covered work, and remove samples of installed materials for testing.
3. Do not cut or alter work performed under separate contracts without the Architect's written permission

A. Section 042000: Unit Masonry

B. Section 095123: Ceramic Tile

D. Section 097763: FRP Wall Panels

1.3. SUBMITTALS

A. Material submittals shall be in accordance with the requirements of Section 013300. Submittals will include catalog cuts of all items listed herein, including installation details.

PART 2 - PRODUCTS

2.1. ACCEPTABLE MANUFACTURERS

A. American Specialties, Inc.

B. Bobrick Washroom Equipment, Inc.

C. Bradley Corporation

D. Boraxo

E. Gojo

F. Rubbermaid

G. Tork, USA

2.2. METAL AND FINISH

A. Accessories shall be fabricated in accordance with good commercial practice. Bending, flanging, drawing, forming and similar operations shall be performed in a manner to insure that there are no ruptures, cracks, wrinkles, sharp exposed edges or other defects. Flanges of recessed accessories shall be designed to return to walls to provide a continuous, tight-against-the-wall installation. Doors shall be warp free. Where specified, locks shall be manufacturer's standard with locks keyed alike for each type accessory: provide two (2) keys for each lock or each group of accessories keyed alike. Tubing for grab bars shall be 1-1/2" diameter with wall thickness not less than 18 gauge, unless otherwise specified. Each accessory item shall be complete with all necessary mounting plates, anchors and fasteners. Generally comply with WW-P-541/GEN and WW-P-541/8.

2.3. CONCEALED ANCHORING DEVICES

A. All anchoring devices shall be type compatible with type of surface material to which accessories are to be attached. Concealed anchoring devices shall be manufacturer's standard wherever possible. Surface-mounted accessories shall be mounted on concealed backplates, except as otherwise specified. Backplates shall be of sturdy construction and may be unpolished or unplated. Accessories without backplates shall have concealed fasteners. For grab bars, provide not less than three (3) tamper-proof, case-hardened, stainless steel screws or bolts of the length approved on the installation drawings. All anchors and fasteners shall be capable of developing a retaining force commensurate with the strength of the accessory to be mounted.

2.4. ACCESSORY ITEMS: See drawings for location of the following items and fixtures (refer to drawings for designations and locations):

Mop Sink Rack - Bobrick #B-224

Hand Soap Dispenser – Provided by Owner, installed by Contractor

Grab Bar 42" - Bobrick #B-6806x42, concealed anchor device

Grab Bar 36" - Bobrick #B-6806x36, concealed anchor device

Toilet Tissue Dispenser – Provided by Owner, installed by Contractor

Paper Towel Dispenser – Provided by Owner, installed by Contractor

Typical Mirror, 18"x36" - Bobrick #B1658 with tempered glass

ADA Fixed Position Tilt Mirror, 18”x36” – Bobrick B-293 Series

Provide 1 Tilt Mirror at each group and at single-user restroom

Utility Hook - Bobrick #B-6707
Provide at single-user restroom on north wall, near door

Sanitary Napkin Disposal - Rubbermaid Mfr# FG614000WHT

PART 3 - EXECUTION

3.1. INSTALLATION

A. General: All accessories shall be installed with concealed devices in accordance with the recommendations and specifications of each item's individual manufacturer. Items shall be mounted at locations indicated on the drawings or where directed by the approved manufacturer's literature. Proper blocking for accessories shall be in accordance with manufacturer's standards. Exposed surfaces of accessories shall be protected with strippable plastic or by other approved means until the installation is accepted.

B. Surface-mounted accessories, except as indicated or specified otherwise, shall be installed with sheet metal screws or wood screws into wood blocking provided between studs behind anchoring points of all accessories.

C. Conform with manufacturer's printed specifications, subject to Architect's approval.

3.2. CLEANING AND PROTECTION

A. Clean all adjacent surfaces.

B. Protect all installed work from damage until acceptance of the building project.

C. Repair or replace damaged work to meet approval of the Architect.

END OF SECTION 102800

SECTION 104413 - FIRE EXTINGUISHER AND CABINETS

PART 1 - GENERAL

1.1. DESCRIPTION

A. Furnish all labor, materials, tools, equipment and services necessary for and reasonably incidental to complete the fire extinguisher and cabinet work as indicated on the drawings or specified.

1.2. RELATED SECTIONS

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. In addition to other requirements specified, upon the Owner’s request uncover work to provide for inspection by the Owner of covered work, and remove samples of installed materials for testing.

C. Do not cut or alter work performed under separate contracts without the Architect's written permission

D. Section 042000: Unit Masonry

E. Section 062000: Finish Carpentry

F. Section 099100: Painting

1.3. QUALITY ASSURANCE

A. Conform to NFPA 101 requirements for portable extinguishers.

B. Provide fire extinguishers, cabinets and accessories by single manufacturer.

1.4. SUBMITTALS

A. Material submittals shall be in accordance with the requirements of Section 013300.

B. Include physical dimensions, operational features, color and finish.

C. Submit manufacturer's installation instructions.

1.5. OPERATION AND MAINTENANCE DATA

A. Submit manufacturer's operation and maintenance data.

B. Include test, refill or recharge schedules, procedures and recertification requirements.

1.6. ENVIRONMENTAL REQUIREMENTS

A. Do not install extinguishers when ambient temperatures may cause freezing.

PART 2 - PRODUCTS

2.1. ACCEPTABLE MANUFACTURERS

A. Larsen's Manufacturing Company

B. J.L. Industries

2.2. MATERIALS

A. Fire Extinguisher Cabinets: The following types are as manufactured by Larsen's Manufacturing Company. Equal products by other manufacturer's will be acceptable.

1. Fire Extinguisher Cabinets: Model No. 2409-R2 cabinet, with V-Duo door. Door shall have **tempered** glass. Cabinet door and trim to be of 18 gauge steel with a factory prime coated finish. Finish paint to be as specified in Section 09900.

2. Location of fire extinguisher cabinets shall be as indicated on the drawings as "FEC" and "FEC-K".

B. Fire Extinguishers: Provide fire extinguishers for each cabinet and other locations indicated, that comply with authorities having jurisdiction:

1. FEC: Multipurpose Dry Chemical Type: UL - rated 4-A:60-B:C, 10 lb. nominal capacity in enameled steel container.

2. FEC: Kitchen: UL - rated Type K, 10 lb. nominal capacity in enameled steel container.

PART 3 - EXECUTION

3.1. INSPECTION

A. Beginning of installation means acceptance of existing conditions.

3.2. INSTALLATION

A. Secure cabinets in place in accordance with manufacturer's instructions in locations indicated on drawings.

B. Fire extinguishers will be placed at such time as is required for occupancy of the building.

END OF SECTION 104413

SECTION 105613 - METAL STORAGE SHELVES

PART 1 - GENERAL

1.1. DESCRIPTION

A. Furnish all labor, materials, tools, equipment and services necessary for and reasonably incidental to complete the metal shelving work, as indicated on the drawings or specified, including but not limited to the following:

1. Metal shelving, as indicated in the Equipment Schedule.

1.2. RELATED SECTIONS

1. 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.
2. Do not cut or alter work performed under separate contracts without the Owner's written permission.

B. Section 079200 - Joint Sealers

1.3. SUBMITTALS

A. Material submittals and catalog cuts shall be in accordance with the requirements of Section 013300.

1.4. GUARANTEE

A. Guarantee all workmanship and material under this section for a period of one (1) year.

PART 2 - PRODUCTS

2.1. ACCEPTABLE MANUFACTURERS

A. Penco - Clipper, HiPerformance Box Formed Shelving

B. Delux - "Heavy Duty" shelving

C. Lyon - Box "W" shelving

D. List - "Hi Tech" shelving

2.2. MATERIALS

A. Commercial/Industrial Steel Shelving Units - Shelving intended for storage with a safe load 800 pounds per shelf capacity.

1. Shelf - 20 gauge with 1-1/4" on all four sides. Front and rear faces shall have four (4) 90 degree bends providing a 3/4" x 1-1/4" tubular shape with a 11/16" wide flange spot welded to shelf at 3" O.C. All shelf parts shall be thoroughly cleaned, phosphasized and finished with 1.25 mil powder coat per EPA standards. Colors shall be standard light colors.
2. Corner Posts - 1-1/8" x 2-1/2" x 14 gauge steel angle, post to be punched for approved shelf clip on 1-1/2" centers for shelf adjustments the full 87" length of post. Color of post to match shelf and finish.

3. Rear and Side Bracing - 12 gauge, X-type. Single units shall have bracing on back and both ends. Multiples of three (3) units shall have x-type bracing on the back center unit and both ends. Multiples of more than three (3) units shall have X-type bracing on back of every second unit and on the sides of every second unit. Back to back and side to side runs shall have common X-type back bracing. Color to match shelf color and finish.
4. Refer to Equipment Schedule for sizing.

END OF SECTION 105613

SECTION 122113 - HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.1. DESCRIPTION

A. Furnish all labor, materials, tools, equipment and services necessary for and reasonably incidental to complete the horizontal blind work as indicated on the drawings or specified, including but not limited to the following:

1. Furnish blinds for all exterior window openings (window W2 at Concessions, and W3 clerestory windows at Team Room under Alternate #1).

1.2. RELATED SECTIONS

A. Section 081113: Hollow Metal Doors and Frames

1.3. GUARANTEE

A. Provide a threeyear written manufacturer's guarantee for all blinds and component parts described in the installation certificate. This guarantee shall be from the date of installation and will cover all defects in materials and workmanship under normal usage.

1.4. SUBMITTALS

A. Material submittals shall be in accordance with the requirements of Section 013300.

B. Color Selection: 'Brushed Aluminum' or similar

PART 2 - PRODUCTS

2.1. ACCEPTABLE MANUFACTURERS

A. Hunter Douglas, Inc.

B. Levolor Corp.

2.2. MATERIALS

A. Hunter Douglas, Inc.: Two-inch aluminum blinds, Model H2TN

B. Levolor Corp.: Rivera 2"

C. Blinds shall be furnished complete with fabric tapes and clear acrylic tilt wand.

D. Blinds shall be furnished complete with all mounting accessories. Color of slats, headrails and bottom rail to match blind color as closely as opsible..

E. Provide wall-mounted cord holders at all blinds. Install at 46" AFF. Mount on the side of the CMU jambs, not on the hollow metal window jambs.

PART 3 - EXECUTION

3.1. Inspection

A. Check that surfaces to which work will be secured are sound and free of irregularities interfering with installation.

B. Do not begin installation until unsatisfactory conditions have been corrected.

3.2. INSTALLATION

A. Installation shall be in accordance with manufacturer's printed instruction and procedures. Blinds shall not be hung on ceiling grid.

B. Assure adequate clearance to permit unencumbered operation.

C. Position units plumb and true and securely anchor in place with brackets, clips and fasteners.

D. Blinds to extend to sill when fully closed.

E. Blinds for exterior doors shall be fixed at the bottom.

3.3. ADJUSTMENT:

A. Adjust clearances and overlaps to insure free operation.

B. Replace damaged items with new material.

C. Repair surfaces damaged by improper installation.

3.4. CLEANING:

A. Remove protective coverings and devices.

B. Clean soiled components and leave work site free of debris.

END OF SECTION 122113

SECTION 122413 ROLLER WINDOW SHADES

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. Manually operated roller shades with single rollers.
   a. Locations:
      1) Exterior Team Room door visions

B. Related Requirements:

1. Section 122113 “Horizontal Louver Blinds”.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of shadeband material.

C. Product Test Reports: For each type of shadeband material, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry 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 operating hardware of operable glazed units through entire operating range. Notify Owner of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Acceptable Manufactures
   a. MechoShade Systems, Inc.
   b. Draper
   c. Spring Window Fashions
   d. CACO, Inc.

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

   1. Bead Chains: Stainless steel.

      a. Loop Length: Full length of roller shade.
      b. Limit Stops: Provide upper and lower ball stops.
      c. Chain-Retainer Type: Chain tensioner, jamb mounted.

   2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.

      a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of interior face of shade.
2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

F. Shadebands:

1. Shadeband Material: Light-blocking fabric, color: black.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.
b. Color and Finish: Black

G. Installation Accessories:

1. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.

a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open.

2. Endcap Covers: To cover exposed endcaps.

3. Provide hold-down brackets installed at bottom of window lites of doors to secure shade.

2.3 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
2. Outside of Jamb Installation: 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.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system and other conditions affecting performance of the Work.

B. 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.

B. Electrical Connections: Connect motor-operated roller shades 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.

END OF SECTION 122413

SECTION 123200 - MANUFACTURED CABINETS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish all labor, materials, tools, equipment and services necessary for and reasonably incidental to complete the casework as indicated on the drawings or specified.

B. Location: Wall cabinets in Concessions room per plan.

1.2 RELATED SECTIONS

A. Section 061000: Rough Carpentry

1.3 QUALITY ASSURANCE

A. Installer: Experienced installer acceptable to the manufacturer.

B. Source Limitations: Obtain manufactured casework from single source from single manufacturer unless otherwise indicated.

C. Field Measurements:

1. Verify dimensions of spaces to receive casework by field measurement. Verify sizes and locations of fillers required for a complete, finished installation. Indicate verified dimensions and filler requirements on shop drawings.

2. Verify sizes and shapes of countertops prior to fabrication by field measurements taken after base cabinets are installed.

D. Quality Standard: Unless otherwise indicated comply with requirements for modular cabinets in AWI's "Architectural Woodwork Quality Standards".

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver manufactured wood casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.5 PROJECT CONDITIONS

C. Environmental Limitations: Do not deliver or install manufactured wood casework until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.6 COORDINATION

D. Coordinate layout and installation of framing and reinforcements in walls and partitions for support of manufactured wood casework. Wall hung supports are to be attached to structure in wall, not wall finish.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of manufactured wood casework that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Delamination of components or other failures of glue bond.
   b. Warping of components.
   c. Failure of operating hardware.
   d. Deterioration of finishes.

2. Warranty Period: Five years from date of Substantial Completion.

1.8 SUBMITTALS

A. Shop drawings and material submittals shall be in accordance with the requirements of Section 013300.

B. Include components dimensions, profiles, finishes and hardware.

C. Submit manufacturer's installation instructions.

D. Submit manufacturer's complete plastic laminate color samples for selection by the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" for grades of casework indicated for construction, finishes, installation, and other requirements.

1. Grade: Custom.

2.2 ACCEPTABLE MANUFACTURERS

A. Manufactured Cabinets and Casework produced in strict compliance with the contract specifications, by the following manufacturers, will be acceptable:

1. Steven’s Advantage, Inc.
2. TMI Systems Design Corp.
3. Russwood Library Furniture
4. Cabinets By Design, Inc.
5. Calmar Manufacturing Company.
6. Case Systems, Inc.
7. Tesco Industries, LP.
8. Mastercraft Woodworking

9. Or approved substitution.

2.3 MATERIALS

A. Basis of Design Products:

1. Stevens Advantage 1200 Tradition or equal from the approved manufacturer's list above.

B. Cabinets: High-pressure plastic laminate surface finish. Flush Overlay type door/drawer style.

1. Particle Board: ANSI A208.1, Grade I-M-2, 45 pcf density, internal bond if 60 psi minimum screw-holding capacity of 225 lbs. on faces and 200 lbs. on edges.

2. Laminate: NEMA LD-3, GP-50 horizontal, GP28" vertical, matte finish. Liner: 0.020" thick.

C. Doors and Drawer Fronts: Plywood with high-pressure plastic laminate surface finish.

D. Shelves: Min. 3/4" plywood with high-pressure plastic laminate surfaces top, bottom and edges. 1" plywood for shelves greater than 36" in length.

1. Wall Cabinet: Unless otherwise noted, all 30" high wall cabinets to have one adjustable shelf, and 36" high wall cabinet to have two adjustable shelves.

2. Base Cabinet: Unless otherwise noted, except for sink units, all 36", 34" and 30" high and 24" deep base cabinets to have one adjustable shelf.

E. Sub-Base: 4-1/4" cabinet sub-base shall be separate and continuous, water resistant exterior grade plywood with concealed fastening to cabinets. Ladder type construction of front, back and intermediates. Wood base to be covered by vinyl base specified in another section of these specifications.

F. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

G. High-pressure plastic laminate face surface of doors and drawers with 3mm PVC edging.

H. All exposed surfaces shall be finished with high-pressure plastic laminate, colors as selected by Architect. Provide backer sheet on all unexposed particle board.

2.4 COUNTERTOPS:

Not applicable.

2.5 HARDWARE

A. Hinges shall be heavy duty, five knuckle 2-3/4" institutional type hinge. Mill ground, hospital tip, tight pin feature with all edges eased. Hinge to be full wrap-around type of tempered steel .093" thick. Each hinge to have minimum seven screws #8, 5/8" F.H.S.M. to assure positive door action and alignment. One pair per door to 48" height. One and one-half pair over 48" in height. Hinge to accommodate 6/16" thick laminated door, and allow 270 degree swing. Finish to be Satin Chrome.

B. Pulls shall be satin chrome wire pull 3-1/2" or as selected and approved by the Architect and/or Owner.

C. Catches

1. LH-340 Magnetic catches for base and wall cabinets. Minimum 6 lb. pull.

2. LH-341 Magnetic catches for tall cabinets. Two per door. Minimum 14 lb. pull per catch.

D. Adjustable shelf clips shall be LH-354 heavy duty shelf support clips with positive locking pin for back two supports on all adjustable shelves. Molded of natural nylon. Alternative method of adjustable shelf locking is to rout out bottom of shelf to exact shape and depth of each shelf support so that shelf fits down over supports.

E. For hinged double doors with cylinder lock, provide top and bottom surface bolt on interior leaf.

F. Locks: Disc tumbler lock individually keyed and master keyed per the building. Dull chrome finish. Provide locks for all units.

2.7 FABRICATION

A. Fabricate casework to ensure durable and rigid unit and to permit plumb and level site installation.

B. Align adjoining units for site assembly modules, to achieve tight, hairline joints.

C. Prepare units with anchor devices to permit ease of site assembly.

D. Prepare countertops with joint devices to ensure hairline site joints.

E. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Seal contact surfaces of cut edges.

F. Finish all exposed ends with high-pressure plastic laminate to match other exposed surfaces.

G. Provide 4-1/4” wood base for all base cabinets to be covered by vinyl base specified in another section of these specifications.

H. Modify casework where indicated, or required but not indicated, to accommodate all mechanical, plumbing and electrical items, etc., when field measuring for casework. Note shall be made of any and all items affecting and requiring casework modification.

I. At base and wall cabinets, provide continuous tops of same height as adjoining casework at blind corner. Provide necessary supports.

J. Install 2” x 8” treated wood support between studs. Top and bottom of partition for wall cabinets and base cabinets to be attached to wall board partition.

2.8 FINISHES

A. Sand substrates smooth and set exposed fasteners. Apply wood filler in exposed fastener indentations.

B. Provide high-pressure plastic laminate backer sheet to all exposed laminate surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of manufactured wood casework.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CASEWORK INSTALLATION

A. Coordinate installation with manufacturer's installation requirements.

B. Install level, plumb, and true; shim as required, using concealed shims. Where manufactured wood casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

C. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Fasten cabinets to masonry or framing, wood blocking, or reinforcements in walls and partitions with fasteners spaced 24 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.

D. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, or framing, blocking, or reinforcements in walls or partitions. Align similar adjoining doors to a tolerance of 1/16 inch.

1. Fasten through back, near top and bottom, at ends, and not more than 16 inches o.c.
2. Use toggle bolts at hollow masonry.
3. Use expansion anchors at solid masonry.
4. Use No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish at metal-framed partitions.
5. Use toggle bolts at plaster on metal lath.
6. Modify casework where indicated, or required but not indicated, to accommodate all mechanical, plumbing and electrical items, etc., when field measuring for casework. Note shall be made of any and all items affecting and requiring casework modification.

E. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

F. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

G. Key all locks in each room alike.

3.3 INSTALLATION OF TOPS

Not Applicable

3.4 INSTALLATION OF SHELVING

A. Securely fasten shelf standards to masonry, partition framing, wood blocking, shelving brackets, or reinforcements in partitions.

1. Fasten shelf standards at ends and not more than 12 inches o.c.
2. Use toggle bolts at hollow masonry.
3. Use expansion anchors at solid masonry.
4. Use self-tapping sheet metal screws in metal framing or metal backing at metal-framed partitions. Do not use wall anchors in gypsum board.

B. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Space standards not more than 30 inches o.c.

C. Install shelving level and straight, closely fitted to other work where indicated.

3.5 CLEANING AND PROTECTING

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

3.6 Protection: Provide 6-mil plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial.

END OF SECTION 123200

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

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. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Concrete bases.
11. Supports and anchorages.

B. Provide all labor, materials, equipment, and services necessary for and incidental to the complete installation and operation of all mechanical work.

C. Unless otherwise specified, all submissions shall be made to, and acceptances and approvals made by the Architect and the Engineer.

D. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered. Arrange piping, equipment, and other work generally as shown on the contract drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawings for approval in accordance with "Submittals" specified below. The right is reserved to make reasonable changes in location of equipment, piping, and ductwork, up to the time of rough-in or fabrication.

E. Conform to the requirements of all rules, regulations and codes of local, state and federal authorities having jurisdiction.

F. Coordinate the work under Division 22 with the work of all other construction trades.

G. Be responsible for all construction means, methods, techniques, procedures, and phasing sequences used in the work. Furnish all tools, equipment and materials necessary to properly perform the work in first class, substantial, and workmanlike manner, in accordance with the full intent and meaning of the contract documents.

H. Coordinate with all exterior work with the sprinkler contractor.

I. Coordinate all exterior work with the site/general trades contractor.

J. The plumbing contractor shall provide all condensate drain piping and all gas piping to mechanical equipment connections.

K. Provide all piping and connections in the kitchen as coordinated with the kitchen contractor and food service drawings.

L. All domestic water system materials shall be NSF61 certified as lead free.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in 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.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

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. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations. Coordinate the work under Division 22 with work of all other construction trades. Conform to the requirements of all rules, regulations, and Codes of local, state, and Federal Authorities Having Jurisdiction.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces.

1.8 PERMITS AND FEES

A. Obtain all permits and pay taxes, fees and other costs in connection with the work. File necessary plans, prepare documents, give proper notices and obtain necessary approvals. Deliver inspection and approval certificates to Owner prior to final acceptance of the work.

B. Permits and fees shall comply with the General Requirements of the specification.

1.9 EXAMINATION OF SITE:

A. Examine the site, determine all conditions and circumstances under which the work must be done, and make all necessary allowances for same. No additional cost to the Owner will be permitted for Contractor's failure to do so.

1.10 CONTRACTOR QUALIFICATION

A. Any Contractor or Subcontractor performing work under Division 22 shall be fully qualified and acceptable to the Architect. Submit the following evidence if requested.
   1. A list of not less than five comparable projects that the Contractor completed.
   2. Letter of reference from not less than three registered professional engineers, Contractors or building owners.
   3. Local and/or State License, where required.
   4. Membership trade or professional organizations where required.

B. A Contractor is any individual, partnership, or corporation, performing work by contract or subcontract on this project.

C. Acceptance of a Contractor or Subcontractor will not relieve the Contractor or subcontractor of any contractual requirements or his responsibility to supervise and coordinate the work, of various trades.

1.11 MATERIALS AND EQUIPMENT

A. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the specified type and quality. This Contractor shall be responsible for connecting all utilities as shown on the drawings, to equipment identified as "under another Division".

B. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish named item, or its equal only of other manufacturers who are indicated in this specification, subject to approval by the Engineer and the Owen J. Roberts School District. Alternate manufacturers or items other than the first-named shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of substituted items, for approval.

C. The suitability of named item only has been verified. Where more than one item is named, only the first named item has been verified as suitable. Alternate manufacturers/items are items other than first named which shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement and application. Manufacturers not named are not acceptable and shall not be submitted.

D. Substitution will not be permitted for specified items of material or equipment where only one manufacturer is identified.

E. The Contractor shall only submit those manufacturers indicated in the specification. Proposed alternate manufacturers must be approved by the Owner and be included into the specifications by Addenda. Substitutions are for materials or manufacturers not listed in this specification. For each substitution proposed by the Contractor, the Contractor shall clearly indicate all differences from the specified item, change in Contract cost, benefit to the Owner and a brief description why the substitution is being proposed. Refer to the General Conditions for additional information. The Owner shall ultimately accept/reject all substitution requests. Refer to the General Conditions of this specification for additional information.

1.12 FIRE SAFE MATERIALS

A. Unless otherwise indicated, materials and equipment shall conform to UL, NFPA OR ASTM Standards for Fire Safety with Smoke and Fire Hazard Rating not exceeding flame spread of 25 and smoke developed of 50.

1.13 REFERENCED STANDARDS, CODES AND SPECIFICATIONS:

A. Specifications, Codes and Standards listed below are included as part of this specification, latest edition.

AABC - Associated Air Balance Council
ABMA - American Boiler Manufacturers Association
ACCA - Air Conditioning Contractors of America
ACGIH - American Conference of Governmental Industrial Hygienist
ADC - Air Diffusion Council
AIHA - American Industrial Hygiene Association
AGA - American Gas Association
AMCA - Air Movement and Control Association
ANSI - American National Standards Institute
ARI - Air Conditioning and Refrigeration Institute
ASA - Acoustical Society of America
ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME - American Society of Mechanical Engineers
ASTM - American Society for Testing and Materials
AWWA - American Water Works Association
CABO - Council of American Building Officials
CAGI - Compressed Air and Gas Institute
CS - Commercial Standard
CSA - Canadian Standards Association
CTI - Cooling Tower Institute
HEI - Heat Exchanger Institute
HI - Hydraulic Institute
HYDI - Hydronics Institute
IAPMO - International Association of Plumbing and Mechanical Officials
IBC - International Building Code
IBR - Institute of Boiler and Radiator Manufacturers
ICBO - International Conference of Building Officials
IEEE - Institute of Electrical and Electronics Engineers
IFCI - International Fire Code Institute
IMC - International Mechanical Code
IPC - International Plumbing Code
MSSP - Manufacturers Standards Society of the Valve and Fittings Industry
NEC - National Electrical Code
NEMA - National Electrical Manufacturers Association
NFPA - National Fire Protection Association
NSF Int. - National Sanitation Foundation
SMACNA - Sheet Metal and Air Conditioning Contractors National Association
TEMA - Tubular Exchanger Manufacturers Association
UL - Underwriters' Laboratories

B. All mechanical equipment and materials shall comply with the Codes and Standards listed in the latest ASHRAE Handbook.

1.14 SUBMITTALS, REVIEW AND ACCEPTANCE:

A. Equipment, materials, installation, workmanship and arrangement of work are subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Engineer to be in best interest of Owner.

B. With 30 calendar days after award of contract, submit a complete Material and Equipment List for approval. List all proposed materials and equipment, indicating proposed manufacturer, type, class, model and other general identifying information.

C. After acceptance of Material and Equipment List, submit complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project.

D. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals. Each piece of equipment and its associated components (e.g., relays, fuses, disconnects, etc.) shall be clearly identified.

E. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.

F. Identify submittals, indicating intended application, location and service of submitted items. Refer to specification sections or paragraphs where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For items other than first-named, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The Contractor shall be responsible for all additional cost and for corrective action (or replacement with the specified item) while maintaining the specification requirements if differences have not been clearly indicated in the submittal.

G. Submit actual operating conditions or characteristics, including NC Levels, for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable.

H. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted.

1.15 SHOP DRAWINGS:

A. Prepare and submit shop drawings for all specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown on contract drawings.

B. Submit data and shop drawings as listed below, in addition to provisions of Paragraph A above. Identify all shop drawings by the name of the item and system and the applicable specification paragraph number.
Items and Systems Not Limited to:

Access Doors.
Backflow Preventer.

Capacitors.
Fire Stopping - Methods and Materials.
Floor & Roof Drains.
Flowmeters and Primary Elements. (Flow Fittings)
Hot Water Heater
Hose Bibbs & Wall Hydrants.
Identification System.
Mixing Valve, Temperature Limiting Valves.
Pipe Guides and Anchors.
Pipes and Fittings.
Plumbing Fixtures & Trim.
Pressure Regulating Valve.
Pressure Reducing Valve.
Pressure Relief Valve.
Sleeves and Sealants.
Strainers.
Thermal Insulation Materials.
Thermometers and Gauges.
Trap Seals.
Valves - Globe, Angle, Check, Plug, Butterfly, Ball.
Vibration Isolation.

C. The Contractor, additionally, shall submit for approval any other shop drawings as required by the Architect. No item listed above shall be delivered to the site, or installed, until approved. After the proposed materials have been approved, no substitution will be permitted except where approved by the Architect.

1.16 SUPERVISION AND COORDINATION:

A. Provide complete supervision, direction, scheduling, and coordination of all work under the Contract, including that of subcontractors.

B. Coordinate rough-in of all work and installation of sleeves, anchors, and supports for piping, and other work performed under Division 22.

C. Coordinate electrical work required under Division 22 with that under Division 26. Coordinate all work under Division 22 with work under all other Divisions.

1.17 CUTTING AND PATCHING:

A. Accomplish all cutting and patching necessary for the installation of work under Division 22. Damage resulting from this work to other work already in place, shall be repaired at Contractor's expense. Where cutting is required, saw-cut or core drill only, and perform work in neat and workmanlike manner. Use mechanics skilled in the particular trades required.

B. Do not cut structural members without approval.

1.18 PENETRATION OF WATERPROOF CONSTRUCTION:

A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls, and interior waterproof construction. Where such penetrations are necessary, furnish and

install all necessary curbs, sleeves, flashings, fittings and caulking to make penetrations absolutely watertight.

B. Where plumbing vents or other pipes penetrate roofs, flash pipe with All American, Inc., or approved equal, roof flashing assemblies, 6-inch skirt, cap, and caulked counterflashing sleeve, installed by Roofing Contractor.

C. Furnish pipe curbs and portals where required. Pitch pockets are prohibited. The Roofing Contractor shall install pipe curbs and portals.

D. Furnish and install roof drains, curbs, vent assemblies, and duct sleeves specifically designed for application to the particular roof construction, and install in accordance with the manufacturer's instructions, The National Roofing Contractors Association, SMACNA and as required by other divisions of this specification. The Contractor shall be responsible for sleeve sizes and locations.

1.19 VIBRATION ISOLATION

A. Furnish and install vibration isolators, flexible connections, supports, anchors, and/or foundations required to prevent transmission of vibration from equipment or piping to building structure.

1.20 ACCESSIBILITY

A. All equipment shall be installed in such a way that all components requiring access are so located and installed that they may be serviced, reset, replaced, recalibrated, etc., by service technicians in accordance with the Manufacturer’s recommendations. If any equipment or components are located in such a position that this Contractor cannot comply with the above, the Contractor shall notify the Engineer in writing before equipment is installed.

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. 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. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless 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.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, galvanized steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
1. Manufacturers:

    a. Cascade Waterworks Mfg. Co.
    b. Dresser Industries, Inc.; DMD Div.
    c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
    d. JCM Industries.
    e. Smith-Blair, Inc.
    f. Viking Johnson.

2. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Eslon Thermoplastics.
b. Charlotte Pipe.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Thompson Plastics, Inc.
b. Charlotte Pipe**.**

D. Plastic-to-Metal Transition Unions: MSS SP-107, PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Manufacturers:

a. NIBCO INC.
b. NIBCO, Inc.; Chemtrol Div.
c. Charlotte Pipe**.**

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Fernco, Inc.
c. Mission Rubber Company.
d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

1. Manufacturers:
a. Epco Sales, Inc.
b. Watts Industries, Inc.; Water Products Div.
c. Flowset.

D. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

1. Manufacturers:

    a. Perfection Corp.
    b. Precision Plumbing Products, Inc.
    c. Sioux Chief Manufacturing Co., Inc.
    d. Victaulic Co. of America.

E. Dielectric Unions and Couplings are prohibited.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Metraflex Co.
    d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless Steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, galvanized, plain ends.

B. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

C. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

C. One-Piece, Floor-Plate Type: Cast-iron floor plate.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

M. Permanent sleeves are not required for holes formed by removable PE sleeves.

N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are two pipe sizes larger than pipe or pipe insulation.
   a. Galvanized Steel Pipe Sleeves: For pipes through walls and floors except where noted through membrane waterproofing.
   b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing. Seal space outside of sleeve fittings with grout.
   c. Provide galvanized steel sheet sleeves for interior stud partitions.
   d. Provide galvanized steel wall sleeves with sleeve seal system for walls below grade and concrete slabs on grade. Select sleeve size to allow one-inch annular clear space between piping and sleeve for installing sleeve seal system. Select type, size and number of sealing elements required for piping material and size for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve 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 water-tight seal.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size two pipe sizes larger than pipe and sleeve for installing mechanical sleeve seals.

Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. 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 unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.
5. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work. Paint bare, untreated ferrous surfaces with rust-inhibiting paint. All exterior components including supports, hangers, vibration isolators, etc., shall be galvanized or stainless steel. All fasteners including nuts, bolts, washers, rods, etc., shall be stainless steel.

D. Clean surfaces prior to application of insulation, adhesives, coatings, paint, or other finishes.

E. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pretreatment.

F. Protect all finishes and restore any finishes damaged as a result of work under Division 22 to their original condition.

G. The preceding requirements apply to all work, whether exposed or concealed.

H. Remove all construction marking and writing from exposed equipment, piping and building surfaces. Do not paint manufacturer's labels or tags.

I. All exposed piping, equipment, cast iron boots, etc. shall be painted. Colors shall be selected by the Architect and conform to ANSI Standards.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 5000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section “Miscellaneous Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.9 SUPPORTS AND HANGERS

A. Provide supports, hangers, braces, attachments and foundations required for the work. Support and set the work in a thoroughly substantial and workmanlike manner without placing strains on materials, equipment, or building structure, submit shop drawings for approval. Coordinate all work with the requirements of the structural division.

B. Supports hangers, braces, and attachments shall be standard manufactured items or fabricated structural steel shapes. All interior hangers shall be galvanized or steel with rust inhibiting paint. For uninsulated copper piping/tubing provide copper clad hanger. All exterior hangers shall be constructed of galvanized steel or stainless steel utilizing stainless steel rods, nuts, washers, bolts, etc.

3.10 PROVISIONS FOR ACCESS:

A. The Contractor shall provide access panels and doors for all concealed equipment, valves, strainers, cleanouts, traps, and other devices requiring maintenance, service, adjustment, balancing or manual operation.

B. Where access doors are necessary, furnish and install manufactured steel door assemblies consisting of hinged door, cam locks**,** and frame designed for the particular wall or ceiling construction. Properly locate each door. All proposed access door locations shall be approved by the Architect prior to installation. Door size shall be a minimum of 24" x 24" unless otherwise approved by the Architect/Engineer. Provide UL Approved and labeled access doors where installed in fire rated walls or ceilings. Doors shall be Milcor Metal Access Doors as manufactured by Inland-Ryerson, or approved equal.
1. Acoustical or Cement Plaster: Style B
2. Hard Finish Plaster: Style K or L
3. Masonry or Dry Wall: Style M

C. Where access is by means of lift-out ceiling tiles or panels, mark each panel using small color-coded or numbered tabs. Provide a chart or index for identification. Charts shall be similar to valve charts specified hereinafter. Provide chart in O & M Manual and in the Boiler Room. Screw markers shall be mounted on the ceiling grid using districts standard for marking and ID.

D. Access panels, doors, etc., described herein shall be furnished under the section of specifications providing the particular service to be turned over to the pertinent trade for installation. Coordinate installation with installing Contractor. Coordinate locations with the Architect prior to installation.

3.11 PROTECTION OF WORK:

A. Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment.

B. Cover temporary openings in piping and equipment to prevent the entrance of water, dirt, debris, or other foreign matter.

C. Cover or otherwise protect all finishes.

D. Replace damaged materials, devices, finishes and equipment.

3.12 OPERATION OF EQUIPMENT:

A. Clean all systems and equipment prior to initial operation for testing, or other purposes. Lubricate, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is authorized for operation during construction.

B. Provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment.

C. Do not use plumbing systems for temporary services during construction unless authorized in writing by the Owner or Architect. Where such authorization is granted, temporary use of equipment shall in no way limit or otherwise affect warranties or guaranty period of the work. All equipment safeties shall be functional and equipment operated within the recommended and designed parameters.

D. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items such as filters, blowdown all strainers, etc.

3.13 IDENTIFICATIONS, FLOW DIAGRAMS, ELECTRICAL DIAGRAMS AND OPERATING INSTRUCTIONS

A. Contractor shall submit for approval schematic piping diagrams of each piping system installed in the building. Diagrams shall indicate valve location, service, type (i.e., butterfly, globe, ball, etc.) make, model number and the identification number of each valve in the particular system.

B. All valves shall be plainly tagged.

C. All items of equipment shall be furnished with white letters and numbers on laminated identification plates using the districts coding system to match districts PM system requirements. Lettering shall be a minimum of 1/4" high. Identification plates shall be securely affixed to each piece of equipment, starters, panels, etc., by screws or adhesive (Tuff-bond #TB2 or as approved equal). Pressure sensitive tape backing is prohibited for all concealed equipment and devices located above drop tile ceilings.

D. Provide three (3) copies of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the "Record and Information Booklet" complete with electronic copy as hereinafter specified.

E. All lines (piping) installed under this contract shall be stenciled with "direction of flow" arrows and with stenciled letters naming each pipe and service.

F. Provide at least 8 hours of straight time instruction to the operating personnel. This instruction period shall consist of not less than one (1) consecutive 8-hour day. Time of instruction shall be designated by the Owner. All instruction periods shall be video-taped and saved on an external hard drive format. Turn two (2) copies of disks over to the Owner after successful demonstration and training.

3.14 WALL AND FLOOR PENETRATION:

A. All penetrations of partitions, ceilings, and floors by piping or conduit under Division 22 shall be sealed and caulked airtight for sound and air transfer control and/or fire stopped for fire walls and floors.

3.15 RECORD DRAWINGS:

A. Upon completion of the plumbing installations, the Contractor shall deliver to the Architect one complete set of the plumbing contract drawings which shall be legibly marked in red pencil to show all changes and departures of the installation as compared with the original design. They shall be suitable for use in preparation of Record Drawings. Additionally the contractor shall provide an electronic copy of the record drawings.

3.16 GUARANTEE:

A. Contractor's attention is directed to guarantee obligations contained in the GENERAL CONDITIONS.

B. The above shall not in any way void or abrogate equipment manufacturer's guarantee or warranty. Certificates of guarantee shall be included in the operations and maintenance manuals.

C. Contractor shall also provide, when due to malfunction, two (2) years free service, from the time of final acceptance by the Owner, to keep the equipment in operating condition. This service shall be rendered upon request when notified of any equipment malfunctions.

D. All refrigeration compressors shall be provided with a five (5) year parts and labor warranty, including replacement of refrigerant.

3.17 LUBRICATION

A. All bearings, motors, and all equipment requiring lubrication shall be provided with accessible fittings for same. Before turning over the equipment to the Owner, the Contractor shall fully lubricate each item of equipment, shall provide one year's supply of lubricant for each, and shall provide Owner with complete written lubricating instructions, together with diagram locating the points requiring lubrication. Include this information in the Record and Information Booklet.

B. In general, all motors and equipment shall be provided with grease lubricated roller or ball bearings with Alemite or equal accessible or extended grease fittings and drain plugs.

C. Provide pressure relief fittings at all grease lubrication locations designed to automatically vent within the range of 1/4 to 1 psi, automatically reset below this range, or another pressure relief range if the preceding differs from the manufacturer's recommended pressure range.

3.18 RECORD AND INFORMATION BOOKLET:

A. The Contractor shall have prepared three (3) copies of the Record and Information Booklet and deliver these copies of the booklet to the Owner. The booklet shall be as specified herein. The booklet must be approved and will not be accepted as final until so stamped.

B. The booklet shall be bound in a three-ring loose-leaf binder similar to "National" No. 3881 with the following title lettered on the front: "Record and Information Booklet (insert name of the project)". No sheets larger than 8-1/2" x 11" shall be used, except sheets that may be neatly folded to 8-1/2" x 11" and used as a pull-out.

C. All booklet information shall also be provided in electronic format, PDF files, stored on an external hard drive. Each binder shall contain an envelope sleeve containing the electronic PDF format media.

D. Provide the following data in the booklet:
1. Catalog data on each piece of plumbing equipment furnished.
2. Maintenance operation and lubrication instructions on each piece of equipment furnished.
3. Complete catalog data on each piece of plumbing equipment furnished, including approved shop drawings.
4. Manufacturer's and Contractors' guarantees.
5. Chart form indicating time and type of routine maintenance of plumbing equipment. The chart shall also indicate tag number, model number of equipment, location and service. For replacement items such as filters, indicate type, size and quantity of the replaceable items.
6. Provide sale and service representatives' names and phone numbers of all equipment and subcontractors.
7. Catalog data of all equipment valves, etc., which shall include wiring diagrams, parts list and assembly drawing.
8. Provide valve chart including valve tag number, valve type, valve model number, valve manufacturer, style, service and location, etc., as specified hereinafter.
9. Provide certification that lead-free and asbestos-free products were provided.
10. Provide operating curves indicating design and balanced conditions for pumps.
11. Provide copies of all flushing reports.
12. Provide copies of all start-up reports.
13. External hard drive of all demonstration and instructional periods.
14. External hard drive of all coordination drawings.

3.19 TESTS, GENERAL:

A. The entire new plumbing systems shall be tested hydrostatically for a duration of four (4) hours before insulation covering is applied and provided tight under the following gauge pressures:
1. Domestic Water & Coil Drain Piping: 100 psi
2. Sanitary & Storm Water Piping as specified below
3. Sanitary & Storm Water Piping as specified below

B. All storm, waste, vent and water piping shall be tested by the Contractor and approved by the Engineer and local code official before acceptance. All storm, soil, and waste piping, located underground, shall be tested before backfilling. The costs of all equipment required for tests are to be included under the contract price.

C. The entire new drainage system and venting system shall have all necessary openings plugged and filled with water to the level of the highest stack above or at the roof. The system shall hold this water for thirty (30) minutes without showing a drop greater than 1". Where a portion of the system is to be tested, the test shall be conducted in the same manner as described for the entire system, except a vertical stack 10 feet above the highest horizontal line to be tested may be installed and filled with water to maintain sufficient pressure, or a pump may be used to supply the required pressure. The pressure shall be maintained for thirty (30) minutes.

D. Upon completion of roughing-in and before setting fixtures, the entire new water piping system shall be tested at a hydrostatic pressure of not less than one hundred (100) pounds per square inch gauge and proved tight at this pressure. Where a portion of the water piping system is to be concealed before completion, this portion shall be tested separately in a manner described for the entire system.

E. All testing shall be witnessed by local code official and the Owner. The Contractor shall provide a minimum of 48-hour notice before testing. The Contractor shall coordinate with and get approval from the Owner.

3.20 LINTELS:

A. Under this Section, provide lintels not provided elsewhere which are required for openings for the installation of plumbing work. Lintels shall meet the requirements of the Architectural and Structural Sections and The Architectural Drawings and Specifications.

3.21 EQUIPMENT BY OTHERS

A. This Contractor shall make all system connections required to equipment furnished and installed under other divisions. Connections shall be complete in all respects to render this equipment functional to its fullest intent.

B. It shall be the responsibility of the supplier of this equipment to furnish complete instructions for connections.

C. Typical equipment refers to, but is not limited to: Kiln hoods, storage cabinets and all other kitchen equipment.

3.22 FASTENERS:

A. All fasteners located in public space, including classrooms, offices, etc., shall be provided with tamper-proof type fasteners where specifically indicated.

3.23 WIRING DIAGRAMS

A. Obtain and submit wiring diagrams for all equipment provided under this Contract.

B. Wiring diagrams shall be provided with Shop Drawings for similar to, but not limited to, the following:

1. All equipment.

C. The Contractor shall submit any additional wiring diagrams as requested by the Engineer.

D. Provide wiring diagrams and identify all termination points, connections, and interface points for all major mechanical equipment to the Electrical Contractor and the ATC Subcontractor for coordination.

3.24 INSTALLATION AND COORDINATION DRAWINGS;

A. Prepare, submit, and use composite installation and coordination drawings to assure proper coordination and installation of work. Drawings shall include, but not be limited, to the following: Complete Ductwork, Plumbing, Sprinkler and HVAC Piping Drawings showing coordination with approved equipment, approved casework drawings, lights, electrical equipment and structural. The Mechanical Contractor is responsible for coordinating with all trades to insure systems will fit in the available space. If conflicts exist after fabrication and/or installation of systems prior to

preparing a coordinated drawing of the area, the Contractor shall remove, re-fabricate, and re-install all such work at their own cost, except for the difference in cost, if any, from the originally designed system to the revised design. If no design changes were made, and clarifications were required, it shall be at no expense to the Owner.

B. Draw plans to a scale not less than 3/8-inch equals one foot. Include plans, sections, and elevations of proposed work, showing all equipment, piping and ductwork in areas involved. Fully dimension all work including hoods, casework and associated utilities, valve boxes, lighting fixtures, conduits, pullboxes, panelboards, and other electrical work, telecommunications equipment, walls, doors, ceilings, columns, beams, joists and other architectural and structural work. Division 23 shall coordinate the development of composite coordination drawings.

C. Identify all equipment and devices on wiring diagrams and schematics. Where field connections are shown to factory-wired terminals, include manufacturer's literature showing internal wiring.

D. All coordination drawings shall be prepared in AutoCAD or Revit format and submitted in color. Different colors shall be used to determine different building components. In addition to the composite coordination drawings, simultaneously submit individual sheet-metal, piping, plumbing and sprinkler coordination drawings.

3.25 BOILER AND PRESSURE VESSELS

A. All boilers and pressure vessels shall be ASME-rated and shall comply with the State of Pennsylvania, latest requirements.

B. Provide all control devices and materials, and install in with ASME CSD-1 controls and safety devices for automatically fired boilers.

3.26 FACTORY START-UP

A. Provide factory authorized start-up service for all plumbing equipment. Coordinate with the Commissioning Agent.

B. Provide one copy of all start-up reports to the Owner and include a copy in the O&M Manual.

C. Tempering Valves: Provide factory-authorized individual to review installation and develop a report to submit to the Engineer. Report submission shall be prior to Engineer's Punch-Out and Demonstration/Training.

D. The Contractor shall be required to start up all systems in an orderly, organized, and coordinated manner to ensure that all systems are functioning as designed. The Contractor shall provide a detailed start-up, testing and demonstration plan for all systems in a coordinated manner that is documented in writing at least forty-five (45) days prior to start-up. Start-up, testing, and demonstration plans shall include detailed point-by-point check list that clearly shows that systems are in face functioning as designed. The A/E shall include modifications to the standard AIA definition of substantial completion to indicate that Mechanical/Electrical Systems are not substantially complete until all systems are started, tested, balanced, and O&M Manuals are received by the Owner. Above listed items must be completed in time to allow for system demonstrations to Owner Personnel with all O&M Manuals in hand at the time of demonstration. Contractors will be required to provide system demonstrations and training for Owner Personnel for each system. At minimum, the Contractors shall provide eight (8) hours of

demonstration and eight (8) hours of systems operation training for each system prior to Owner acceptance of any given system.

3.27 PLUMBING INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of plumbing systems, materials, and equipment including, but not limited to, the following:

1. Coordinate plumbing 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 mounting heights are not detailed, noted, 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.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished space.
10. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of equipment components in accordance with manufacturers' recommendations. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install access panels or doors where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Install above-ceiling equipment requiring servicing and/or maintenance within 48" of accessible ceilings/access panels.
14. Test and balance the domestic hot water/hot water recirculation system.
15. Where different pipe sizes are indicated on the Drawings, the largest pipe size shall be used for the basis of the Bid.

3.28 SCHEDULING OF WORK AND OUTAGES

A. All required outages shall be coordinated with and approved by the Owner a minimum of fourteen (14) days in advance. Written notice of not less than fourteen (14) calendar days shall precede any outage. The Contractor shall include in their bid outages and/or work in occupied areas to occur during weekends, holidays, or at night. No outages are allowed during school hours.

B. All temporary utilities shall be provided by and paid for by the Contractor. All utilities serving the existing building(s) shall be maintained; or temporary piping, equipment, etc., shall be provided

so as not to affect the normal function and operation of the building and its systems. Coordinate these requirements with the Owner.

END OF SECTION 22 05 00

SECTION 220513 – COMMON MOTOR REQUIREMENTS FOR PLUMBING 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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Split phase.
2. ECM.

B. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

C. Motors 1/20 HP and Smaller: Shaded-pole type or ECM as indicated on the drawings.

D. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 220519 – METERS AND GAUGES 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.

1.2 SUMMARY

A. Section Includes:

1. Liquid in glass thermometers.
2. Thermowells.
3. Dial-type pressure gauges.
4. Gauge attachments.
5. Test plugs.
6. Test-plug kits.
7. Sight flow indicators.

B. Related Sections:

1. Division 21 fire-suppression piping Sections for fire-protection pressure gauges.
2. Division 22 Section "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
3. Division 22 Section " Domestic Water Piping" for water meters inside the building.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Certificates: For each type of meter and gauge, from manufacturer.

C. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

D. NSF-61 and HB 372 compliance for all products that will come in contact with potable water.

1.4 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of meter and gauge from single source from single manufacturer.

B. NSF Compliance: NSF 61 and ANSI 372 Certified Lead Free for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial Style, Liquid-in-Glass Thermometers.

1. Basis-of-Design Product: Subject to compliance with requirements, provide H.O. Trerice Model BX9 Industrial thermometer or comparable product by one of the following:
    a. Ashcroft, Inc.
    b. Miljoco Corporation.
    c. Trerice, H.O. Co.
    d. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: Cast aluminum 9-inch (229-mm) nominal size unless otherwise indicated.
4. Case Form: Back angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg F (deg C).
7. Window: Glass.
8. Stem: Brass adjustable angle, brass stem and of length to suit installation.
    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: Brass.
4. Material for Use with Steel Piping: Brass.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

C. Where wells are installed in pipe tees at turns, increase pipe size so that well does not restrict flow.

2.3 PRESSURE GAUGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Trerice, Model 600C, or comparable product by one of the following:
    a. Ashcroft Inc.
    b. Ernst Flow Industries.
    c. Miljoco Corporation.
    d. Noshok.
    e. Weiss Instruments, Inc.
2. Standard: ASME B40.100.
3. Case: Liquid-filled, sealed, type(s); cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.
12. All gauges at pumps shall be liquid filled type.

2.4 GAUGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass threaded needle valve with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 (DN 8) or NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 300 psig at 250 deg F (2070 kPa at 121 deg C).

F. Core Inserts: EPDM self-sealing rubber.

2.6 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C).

D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C).

E. Pressure Gauge: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa).

F. Carrying Case: Metal or plastic, with formed instrument padding.

2.7 SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Archon Industries, Inc.
2. Dwyer Instruments, Inc.
3. Emerson Process Management; Brooks Instrument.
4. Ernst Co., John C., Inc.
5. Ernst Flow Industries.
6. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
7. OPW Engineered Systems; a Dover company.
8. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 125 psig (860 kPa).

E. Minimum Temperature Rating: 200 deg F (93 deg C).

F. End Connections for NPS 2 (DN 50) and Smaller: Threaded.

G. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gauge for fluids.

H. Install test plugs in piping tees.

I. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
2. Where indicated on the drawings.

J. Install pressure gauges in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump, liquid filled.
4. Where indicated on the drawings.

3.2 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gauges to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:

1. Compact, industrial-style, liquid-in-glass type.
2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C).

B. Scale Range for Domestic Hot-Water and recirc Piping: 30 to 240 deg F (0 to plus 115 deg C).

3.6 PRESSURE-GAUGE SCHEDULE

A. Pressure gauges at discharge of each water service into building, at the discharge of pressure reducing valves and master mixing valves, at suction and discharge of pumps and water heaters and where indicated on the drawings shall be selected so that the normal readings are at the approximate mid-point and maximum pressures. Do not exceed full scale.

END OF SECTION

SECTION 220523 - 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.

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Bronze lift check valves.
3. Bronze swing check valves.
4. Bronze globe valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61Certified Lead Free for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4” and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 3 and smaller.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 2 plug valves, for each size square plug-valve head.

5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
f. NIBCO.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: 2” and Smaller Full Port, 2-1/2” and Larger Standard Port.

2.3 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.5 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

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.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball valves.
2. Throttling Service: Globe or ball.
3. Pump-Discharge Check Valves:

a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze disc.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded or solder joint valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 4 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port (2" and smaller), standard port (2-1/2" and larger), bronze with stainless-steel trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Globe Valves: Class 125, bronze disc.

END OF SECTION 22 05 23

SECTION 220529 - HANGERS AND SUPPORTS 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.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Pipe positioning systems.
7. Equipment supports.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 21 fire-suppression piping Sections for pipe hangers for fire-suppression piping.
3. Division 22 Section "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing 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.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of cadmium plated or stainless steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-clad hanger, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of cadmium plated or stainless steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Clement Support Services.
2. ERICO International Corporation.
3. National Pipe Hanger Corporation.
4. PHS Industries, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: 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.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.

C. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb. Supports shall be hot-dipped galvanized construction. All fasteners, washers, etc., shall be stainless steel.

2.6 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes, hot-dipped galvanized construction.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black (painted) and galvanized.

B. Grout: ASTM C 1107, 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 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. 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 framing 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 (100 mm) 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.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.

G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

J. 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.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. 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 (DN 65) 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.

M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe hangers and supports shall be attached to the panel point at the top chord of bar joist or at a location approved by the structural engineer. Do not support all parallel piping from the same bar joist (4" pipe and larger) unless approved by structural engineer.

O. 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.

P. 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 (DN 100) 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 (DN 100) 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 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
    b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
    c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.

5. Pipes NPS 8 (DN 200) 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 same thickness as piping insulation.

3.2 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.

3.3 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.

3.4 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 (40 mm).

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as 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 areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 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 finish.

D. Use copper or copper clad attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use painted or galvanized carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications. Use stainless steel pipe hangers and attachments for exterior applications.

F. Use thermal-hanger shield inserts for insulated piping and tubing.

G. Horizontal-Piping Hangers and Supports: 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 noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
3. Adjustable Roller Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
    a. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
    b. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

H. 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 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
2. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape at the panel point.

   2. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

   3. Side Beam Clamps (MSS Type 27): For bottom of steel I-Beams.

K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
   2. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

L. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system sections.

M. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply waste piping for plumbing fixtures.

END OF SECTION 22 05 29

SECTION 220553 - 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.

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 SUBMITTALS

A. Product Data: For each type of product indicated.

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 with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), 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.

B. Label Content: Include equipment's Drawing designation or unique equipment number based on PM Identification System of the school district, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus 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, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Black.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), 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

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, snap-on semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive (4" and less). For larger pipe (sizes 6" and greater) markers shall be strapped around using nylon ties.

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.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME (ANSI) A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME (ANSI) A13.1 unless otherwise indicated.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) black-filled letters for piping system abbreviation and 1/2-inch (13-mm) black-filled numbers, 2-inch diameter.

1. Tag Material: Brass, 19 gauge minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass jack chain.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) 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.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches (100 by 178 mm).
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09.

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME (ANSI) A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. 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 for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit 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 (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
8. Where pipes are adjacent to each other, markings shall be neatly lined up. All markings shall be located in such a manner to be easily legible from the floor.
9. For piping less than 3/4 inch, provide permanently legible tag as specified hereinbefore for valve identification.
10. For buried piping, provide 2-inch minimum width with plastic identification/detection tape with metallic core. Install 4 to 6-inches below-grade.

D. Pipe Label Color Schedule:

1. Natural Gas:

a. Background Color: Yellow.
b. Letter Color: Black.

2. Domestic Water Piping:

a. Background Color: Green.
b. Letter Color: White.

3. Sanitary Waste and Storm Drainage Piping:

a. Background Color: Green.
b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Cold Water: 2 inches (50 mm), round.
b. Hot Water: 2 inches (50 mm), round.
c. Natural Gas: 2 inches (50 mm), round.

2. Valve-Tag Color:

a. Cold Water: Natural.
b. Hot Water: Natural.
c. Natural Gas: Natural.

3. Letter Color:

a. Cold Water: Black.
b. Hot Water: Black.
c. Natural Gas: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 22 05 53

SECTION 220700 - PLUMBING INSULATION

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. Insulation Materials:

a. Calcium silicate.
b. Flexible elastomeric.
c. Mineral fiber.

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 include the following:
1. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

E. Field quality-control reports.

1.4 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. Fire-Test-Response Characteristics: Insulation and related materials shall 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, tapes, 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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. 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.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Calcium Silicate:

1. Products: Subject to compliance with requirements, provide the following:

   a. Owens-Corning.
   b. Johns Mansville.

2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
3. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

G. 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: Subject to compliance with requirements, provide the following:

   a. Johns Mansville.
   b. Armacell LLC; AP Armaflex.
   c. Aeroflex USA, Inc.; Aerocel.
   d. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

H. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Johns Manville; Micro-Lok.
   b. Knauf Insulation; 1000(Pipe Insulation.
   c. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. CertainTeed Corp.; CrimpWrap.
   b. Johns Manville; MicroFlex.
   c. Knauf Insulation; Pipe and Tank Insulation.
   d. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Insulco, Division of MFS, Inc.; Triple I.
   b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

2.3 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. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F (10 to 427 deg C).

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Products, Division of ITW; CP-97.
   b. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
   c. Marathon Industries, Inc.; 290.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Products, Division of ITW; CP-82.
   b. Foster Products Corporation, H. B. Fuller Company; 85-20.
   c. ITW TACC, Division of Illinois Tool Works; S-90/80.
   d. Marathon Industries, Inc.; 225.
   e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. 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: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Chemical Company (The); 739, Dow Silicone.
b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Speedline Vinyl Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-30.
    b. Foster Products Corporation, H. B. Fuller Company; 30-35.
    c. ITW TACC, Division of Illinois Tool Works; CB-25.
    d. Marathon Industries, Inc.; 501.
    e. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; Encacel.
    b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
    c. Marathon Industries, Inc.; 570.
    d. Mon-Eco Industries, Inc.; 55-70.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-10.
    b. Foster Products Corporation, H. B. Fuller Company; 35-00.
    c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
    d. Marathon Industries, Inc.; 550.
    e. Mon-Eco Industries, Inc.; 55-50.
    f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms (2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F (Minus 29 to plus 93 deg C).
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-52.
b. Foster Products Corporation, H. B. Fuller Company; 81-42.
c. Marathon Industries, Inc.; 130.
d. Mon-Eco Industries, Inc.; 11-30.
e. Vimasco Corporation; 136.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
4. Service Temperature Range: Minus 50 to plus 180 deg F (Minus 46 to plus 82 deg C).
5. Color: White.

2.6 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

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 (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-76.

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 (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms (0.013 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

    a. Products: Subject to compliance with requirements, provide the following:

        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

5. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms (0.007 metric 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.

    a. Products: Subject to compliance with requirements, provide the following:

        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

    a. Products: Subject to compliance with requirements, provide the following:

        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.8 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

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. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

    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, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Products, Division of ITW; Metal Jacketing Systems.
   b. PABCO Metals Corporation; Surefit.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.

   a. Sheet and roll stock ready for shop or field sizing.
   b. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
   d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
   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.

D. Underground Direct-Buried Jacket: 125-mil- (3.2-mm-) 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: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Pittsburgh Corning Corporation; Pittwrap.
   b. Polyguard; Insulrap No Torch 125.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

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.

2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) 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.

1. Products: Subject to compliance with requirements, provide one of the following:

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.

2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) 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: Subject to compliance with requirements, provide one of the following:

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.

2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

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.

2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.

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. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.

2. Width: 3 inches (75 mm).
3. Film Thickness: 6 mils ((0.15 mm)).
4. Adhesive Thickness: 1.5 mils (0.04 mm).
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

2.11 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

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 304 or Type 316; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide with wing or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) 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- (3.5-mm-) diameter shank, length to suit depth of insulation indicated.

a. Products: Subject to compliance with requirements, provide one of the following:

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- (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

    a. Products: Subject to compliance with requirements, provide one of the following:

        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: Subject to compliance with requirements, provide one of the following:

        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 (0.76 mm) thick by 2 inches (50 mm) square.
    c. Spindle: Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) 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: Subject to compliance with requirements, provide one of the following:

        1) GEMCO; Nylon Hangers.
        2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

    b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
    c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
    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. Self-Sticking-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: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
2) GEMCO; Press and Peel.
3) Midwest Fasteners, Inc.; Self Stick.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
c. Spindle: Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Products: Subject to compliance with requirements, provide one of the following:

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.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Products: Subject to compliance with requirements, provide one of the following:

1) GEMCO.
2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.
b. Childers Products.
c. PABCO Metals Corporation.
d. RPR Products, Inc.

2.12 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel accord.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment 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. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, 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.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) 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.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. 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.

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 (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground 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 (50 mm).
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.

1. Comply with requirements in Division 07 Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. 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.
3. Protect exposed corners with secured corner angles.
4. 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 (75 mm) from insulation end joints, and 16 inches (400 mm) 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.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. 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 (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) 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 (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches (75 mm).
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. 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. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe 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 insulation to fit. Butt each section closely to the next and hold in place with tie 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 (50 mm) 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 CALCIUM SILICATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

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 block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

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 insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

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.

3.9 MINERAL-FIBER 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.
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 (150 mm) 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 (25 mm), 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.

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 (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) 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 (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) 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 (25-mm) 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 (50-mm) 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 (300 mm) o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches (50 mm) over the previous section. Adhere lap seal using

adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.

3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. The 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.11 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

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 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.13 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

C. Domestic cold-water storage tank insulation shall be the following, of thickness to provide an R-value of 12.5:
1. Mineral-Fiber Board: 3-lb/cu. ft. (48-kg/cu. m) nominal density.

3.14 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Underground piping.

3.15 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. Two-inch (2”) pipe size and Smaller: Insulation shall be the following:
a. Molded fiberglass 1-inch thick.

2. Two-and-one-half-inch (2-1/2”) pipe size and Larger: Insulation shall be the following:
a. Molded fiberglass 1-1/2 inch thick.

3. Half-inch (1/2”) run-out piping: Insulation shall be one of the following:
a. Molded fiberglass 1-inch thick.
b. Flexible Elastomeric: 1-inch (25 mm) thick.

B. Domestic Hot and Recirculated Hot Water:

1. One-and one-quarter-inch (1-1/4”) pipe size and Smaller: Insulation shall be the following:
a. Molded fiberglass 1-inch thick.

2. One and one-half-inch (1-1/2”) and Larger: Insulation shall be the following:
a. Molded fiberglass 1-1/2 inch thick.

3. Half-inch (1/2”) run-out piping: Insulation shall be one of the following:
a. Molded fiberglass 1-inch thick.
b. Flexible Elastomeric: 1 inch (25 mm) thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be the following:
a. Molded fiberglass 1-inch thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch (25 mm) thick.
   b. Molded fiberglass 1-inch thick.

E. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch (25 mm**)** thick.
   b. Molded fiberglass 1-inch thick.

F. Exposed Sanitary Drains, domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
1. All Pipe Sizes: Insulation shall be Truebro Lav Guard – ADA approved undersink pipe insulation cover system. Refer to Section 224000 for additional information on protective shielding guards.

G. Floor Drains, Traps, and Sanitary Drain Piping within 10 feet (3m) of drain receiving condensate and equipment drain water below 60 degrees F (16 degrees C):
1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-inch (25 mm) thick.

H. Hot Service Drains:
1. All Pipe Sizes: Insulation shall be the following: Mineral-Fiber, Preformed Pipe, Type I or II: 1-inch (25 mm) thick.

I. Hot Service Vents:
1. All Pipe Sizes: Insulation shall be the following: Mineral-Fiber, Preformed Pipe, Type I or II: 1-inch (25 mm) thick.

J. Piping with Heat Trace:
1. All pipe sizes (exterior condensate drain and refrigerator/freezer condensate drain piping): Insulation shall be the following: Mineral-Fiber, Preformed Pipe, Type I or II: 1-inch (25 mm) thick.

3.16 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Exposed, up to 48 inches (1200 mm) in Diameter or with Flat Surfaces up to 72 inches (1800 mm):
1. PVC: 30 mils (0.8 mm) thick.

D. Equipment, Exposed, Larger than 48 inches (1200 mm) in Diameter or with Flat Surfaces Larger than 72 inches (1800 mm):
1. Aluminum with 0.040 inch (1.0 mm) thick.

E. Piping, Concealed:
1. None.

F. Piping, Exposed (including mechanical rooms, occupied areas) and/or Heat Traced:
   1. Indoor PVC: 20 mils (0.5 mm) thick, Green with White lettering for identification).
   2. Exterior – Aluminum: 0.040 inch thick.

END OF SECTION 22 07 00

SECTION 221113 - WATER MAINS

PART 1 - GENERAL

1.1. DESCRIPTION

A. The contractor shall furnish all materials equipment, tools, and labor necessary to perform and complete the work under this contract as required by these specifications, indicated on plans, or as directed by the Owner.

B. The contractor shall also do all the necessary clearing, remove paved and unpaved surfaces in the line of work as required by State and/or local agencies having jurisdiction over the work or as directed by the Owner.

C. The water mains shall be installed at the elevations indicated on the drawings. Earth cover in the refill trench shall not be less than three- and one-half feet (3 ½') over the top of the pipe unless indicated otherwise on the drawings or approved by the Owner.

1.2. QUALITY ASSURANCE

A. During the progress of the work, maintain and accurate record of the location of the piping with references to job base lines, grades and elevations. Show all changes made in the piping installation from the layout and materials shown on the approved shop drawings.

B. The Contractor will retain testing and monitoring services of a Registered Professional Geotechnical Engineer, at the contractor's expense to perform field and laboratory testing during water main operations and to provide quality assurance of compliance with the Drawings and Specifications. Testing rates are to be determined by the Registered Professional Geotechnical Engineer to ensure certification of construction for acceptance by the governing agency. Five copies of testing reports are to be provided to the owner.

C. Use all means necessary to protect the materials of the section before, during, and after installation and to protect the installed work and materials of all other trades.

D. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner and at no additional cost to the Owner.

E. Deliver, store, and handle materials in accordance with manufacturer's instructions. Materials are to be stored in areas that will not impede construction progress.

F. Upon completion of work for this section the Contractor will provide as-built surveys performed by a Licensed Land Surveyor or Engineer, the as built is to ensure certification of construction for acceptance by the governing agency. Five copies of the as-builts are to be provided to the owner.

G. If any construction is not in compliance with the design requirements the contractor will provide compliance at no additional cost to the Owner.

1.3. SUBMITTALS

A. The contractor is to provide the Owner with five (5) submittals for all materials covered under this section, and material certificates. Certificates are to be signed by Material Producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

PART 2 - PRODUCTS

A. PVC pipe shall be in accordance with AWWA C-900 Class 150 (DR-18) in sizes four inch (4”) and larger.

B. Fittings shall be ductile iron compact fittings with mechanical joints meeting the requirements of AWWA C153. All fittings shall be double cement lined per AWWA C104 and coated on the exterior with an asphaltic coating. Gaskets shall be in accordance with ASTM F-477.

C. Water services less than 3-inches in diameter shall be SDR 21 gasketed PVC water pipe that meets the requirements of ASTM D 2241 and ASTM D 1784: PVC 1120. The pipe is to have an integral bell that utilizes a gasket for sealing that meets ASTM F477. Water services less than 3-inches in diameter may also be HDPE meeting the requirements of ASTM D 3035 of ASTM F 714 without joints.

D Valves shall be resilient wedge Gate type conforming to AWWA C-509 and shall have a working pressure rating of at least 250 psi. Gate valves shall open counter clockwise.

E. Valve boxes shall be Screw Type Adjustable Bingham-Taylor 4900 series with Water lettered top. Valve box is to accommodate the water main valve size stated on plans. Screw extension provided as required.

F. Tracer wire shall be as shown on contract drawings. Detector tap shall be 3 inches wide (minimum) nonmetallic blue plastic tape lettered “water” in yellow graphics.

PART 3 - EXECUTIONS

A. All pipe and fittings shall be thoroughly cleaned and shall be entirely fee free from grease or oil and substantially free from blacking, dirt, sand, rust slag or fluxing materials.

B. PVC pipe shall be installed in accordance with Unibell Handbook of PVC Pipe, Chapter VI Construction “Recommended Construction Practices for PVC Pipe”.

C. Hydrants, valve boxes, and trench excavations and backfill are to be in accordance with Section 312000 Earthwork and Section 330500 Excavation, Backfill and Protection of Trenches.

D. A valve box shall be provided for every valve and shall be carefully placed and set at a right angle to the water main.

E. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve, with the box cover flush with the surface of the finished pavement or set to the elevation shown on the drawings. The flange at the bottom of the top section shall rest upon planks, which shall extend into solid ground on each side of the trench for a minimum of eight inches.

F. In tamping the backfill around the valve, special care shall be taken to keep the box in place and to have it firmly supported so as to avoid settlement. Any box which is ground out pf place or which is not firmly supported shall be dug up and reset in a satisfactory manner at the Contractor's expense.

G. All fittings shall be firmly blocked with concrete against undisturbed earth as shown in the details.

H. For valve boxes not placed in roadway areas, but in graded areas, the top shall be set at the existing finished grade or as directed by the Owner.

I. A magnetic detector wire shall be placed above the water main. The wire shall run continuously over the water main and as shown on contract drawings. Detector tape shall run continuously over the water main 12 inches below the surface at final grade.

K. Do not cover up or enclose work until it has been properly and completely inspected and approved.

L. Should any of the work be covered up or enclosed prior to all required inspections and approval, uncover work as required and, after it has been completely inspected and approved, make all repairs and replacements with such materials as are necessary to the approval of the Owner and at not additional cost to the Owner.

M. Water Mains shall be pressure and leakage tested in accordance with AWWA C-900, Uni-Bell Plastic pipe Association and as specified herein.

N. Test pressure shall be 1.5 times normal operating pressure and there shall be no pressure loss for a two-hour test period. Tests and are to be performed under the observance of the county inspector if within the county right of way, and the owner's representative if onsite. The inspector or owner's representative is to be notified at least 3 working days prior to the scheduled tests.

O. Disinfection procedures shall be completed in accordance with AWWA C-651, Maryland Department of the Environment regulations and as required by the local county agency, and as specified on contract documents. The Tablet method will not be acceptable for the project. Bacteriological testing shall be by a state certified laboratory.

P. The Contractor shall furnish all labor, tools, materials, equipment, gauges and meters necessary for making the tests and chlorinating the mains.

Q. Water used for disinfection shall be properly disposed by the Contractor in accordance with a method approved by the Owner and the Maryland Department of the Environment. If the water is heavily chlorinated, it shall be neutralized prior to disposal.

END OF SECTION

SECTION 221116 - DOMESTIC WATER 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. Piping Materials.
2. Copper Tube and Fittings
3. Ductile Iron Pipe and Fittings
4. Piping Joining Materials.
5. Transition Fittings
6. Dielectric Fittings
7. Specialty valves.
8. Flexible connectors.
9. Water Meters.

B. Related Section:

1. Division 22 Section "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.3 SUBMITTALS

A. Product Data: For the following products:

1. Specialty valves.
2. Piping
3. Transition fittings.
4. Dielectric fittings.
5. Flexible connectors.
6. Backflow preventers and vacuum breakers.
7. Water penetration systems.

B. Water Samples: Specified in "Cleaning" Article.

C. Coordination Drawings: For all piping, draw to 3/8” scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Fire-suppression-water piping.
2. Domestic water piping.
3. HVAC hydronic piping.
4. Equipment.
5. Ductwork.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube Above-Ground: ASTM B 88, Type L water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Soft Copper Tube Below Building Slab: ASTM B 88, Type K (ASTM B 88M, Type A) water tube, annealed temper.

1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2. Press fittings are not permitted.

2.3 DUCTILE IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
2. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.

    a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
3. Lining: AWWA C104, cement mortar.
4. Gaskets: AWWA C111, rubber.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, galvanized steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cascade Waterworks Manufacturing.
b. Dresser, Inc.; Dresser Piping Specialties.
c. Smith-Blair, Inc; a Sensus company.
d. Viking Johnson; c/o Mueller Co.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. EPCO Sales, Inc.
   b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   c. Hart Industries International, Inc.

2. Description:

a. Factory-fabricated, bolted, companion-flange assembly.

b. Pressure Rating: 150 psig (1035 kPa).
c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

C. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Perfection Corporation; a subsidiary of American Meter Company.
b. Precision Plumbing Products, Inc.
c. Victaulic Company.

2. Description:

a. Electroplated steel nipple complying with ASTM F 1545.
b. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
c. End Connections: Male threaded or grooved.
d. Lining: Inert and noncorrosive, propylene.

D. Dielectric unions and couplings are prohibited.

2.7 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld, Inc.
5. Hyspan Precision Products, Inc.
6. Mercer Rubber Co.
7. Metraflex, Inc.
8. Proco Products, Inc.
9. Tozen Corporation.
10. Unaflex, Inc.
11. Universal Metal Hose; a Hyspan company
12. Mason Industries.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

2.8 WATER METERS

A. Displacement-Type Water Meters (1-1/4” and Smaller):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Seametrics
b. Badger Meter, Inc.
c. Sensus Metering Systems.
d. Hersey Meter.

2. Description:

a. Standard: AWWA C700.
b. Pressure Rating: 150-psig (1035-kPa) working pressure.
c. Body Design: Nutating disc; totalization meter.
d. Registration: In gallons or cubic feet as required by utility. In gallons for make-up water and other building sub-metering requirements.
e. Case: Bronze.
f. End Connections: Threaded.
g. Energy Management: Connection to the BACNET (Building Management System).

B. Electromagnetic-Type Water Meters (1-1/2" and Larger):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Seametrics
b. Badger Meter, Inc.
c. Sensus Metering Systems.
d. Hersey Meter.
e. Onicon.

2. Description:

a. Standard: AWWA C701.
b. Pressure Rating: 150-psig (1035-kPa) working pressure.
c. Body Design: Turbine; totalization meter.
d. Registration: In gallons or cubic feet as required by utility company. In gallons for make-up water and other building sub-metering requirements.
e. Case: Stainless Steel.
f. End Connections for Meters NPS 2 (DN 50) and Smaller: Threaded.
g. End Connections for Meters NPS 2-1/2 (DN 65) and Larger: Flanged.
h. Energy Management: Connection to the BACNET Building Management System.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install shutoff valve, hose-end drain valve, strainer, pressure gauge, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gauges for Plumbing Piping" for pressure gauges and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.

G. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

I. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

K. Install piping adjacent to equipment and specialties to allow service and maintenance.

L. Install piping to permit valve servicing.

M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

Q. Install liquid filled pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22.

R. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22.

S. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22.

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22.

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22.

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22.

W. Install underground copper tube and ductile iron pipe in PE encasement according to ASTM A674 or AWWA C105.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. 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.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

H. Ductile-Iron-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join ductile-iron pipe and grooved-end fittings according to AWWA C606 for ductile-iron-pipe, cut-grooved joints.

I. Steel-Piping Grooved Joints: Roll groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

J. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

3.4 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, for each branch serving toilet room(s), for each branch pipe serving two or more fixtures, and on each water supply to plumbing fixtures that do

not have supply stops. Use ball valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves for piping NPS 2-1/2 (DN 65) and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section.

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

D. Install combination balancing/shut-off valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22.

3.5 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
2. NPS 2 (DN 50) and Larger: Sleeve-type coupling.

3.6 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric nipples only.

C. Dielectric Fittings for NPS 2-1/2 and larger: Use dielectric flanges only.

3.7 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump.

B. Install bronze-hose flexible connectors in copper domestic water tubing.

3.8 WATER METER INSTALLATION

A. Rough-in domestic water piping and install water meters according to utility company's requirements and/or as required for building sub-metering.

B. Install water meters according to AWWA M6 and/or the utility company's requirements

C. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.

D. Install turbine-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.

E. Install remote registration system according to standards of utility company and of authorities having jurisdiction.

F. Provide remote reading for integration with the BACNET Building Control System.

3.9 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m) If Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
5. NPS 3 (DN 80): 10 feet (3 m) with 1/2-inch (13-mm) rod.
6. NPS 4 (DN 150): 12 feet (3 m) with 5/8-inch (16-mm) rod.
7. NPS 6 (DN 200): 12 feet (3 m) with 3/4-inch (19-mm) rod.

F. Install supports for vertical copper tubing every 10 feet (3 m).

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32) and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1-1/2 (DN 40): 96 inches with 3/8-inch rod.
3. NPS 2 (DN 50): 8 feet with 3/8-inch rod.
4. NPS 2-1/2 (DN 65): 10 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
6. NPS 4 (DN 100): 14 feet with 5/8-inch rod.
7. NPS 6 (DN 150): 16 feet with 3/4-inch rod.

8. NPS 8 to NPS 12 (DN 200 to DN 300): 20 feet with 7/8-inch (22-mm) rod.

H. Install supports for vertical steel piping every 15 feet (4.5 m).

I. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

J. Hangers shall be connected to top chord panel points at joist locations.

3.10 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.11 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.
7. Testing with air in lieu of water shall be at the Owner's discretion dependent upon weather conditions.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.13 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.14 CLEANING

A. Clean and disinfect potable and non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:
        1) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until chlorine level is <1.0 ppm in water coming from system after the standing time.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
    e. Submit testing results to Architect.

3.15 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-ground, domestic water piping, NPS 1 to NPS 3, shall be the following:

1. HDPE tube and fittings, Fusion welded joints.

D. Above Ground Water Piping:
1. All aboveground domestic water piping shall be the following
    a. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) or wrought- copper solder-joint fittings; and soldered joints.
2. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be the following:
    a. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B)] copper solder-joint fittings; and soldered joints.
3. Under-Building Slab, Domestic Water Piping:
    a. Type K, annealed-temper soft copper tubing, wrought copper fittings and solder joints.

3.16 VALVE SCHEDULE

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 for piping NPS 4 (DN 100) and smaller. Use ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
2. Throttling Duty: Use ball valves for piping NPS 4 (DN 100) and smaller. Use ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 22 11 16

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

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 domestic water piping specialties:

1. Vacuum breakers.
2. Balancing valves.
3. Temperature-actuated water mixing valves.
4. Strainers.
5. Hose bibbs.
6. Wall hydrants.
7. Drain valves.
8. Water hammer arresters.
9. Air vents.
10. Trap-seal primer valves.
11. Trap-seal primer systems.

B. Related Sections include the following:

1. Division 22 Section "Meters and Gauges for Plumbing Piping" for thermometers, pressure gauges, and flow meters in domestic water piping.
2. Division 22 Section "Domestic Water Piping" for water meters.
3. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.
4. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa), unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:
1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
2. All components shall be certified as Lead Free in accordance with NSF 61.

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Ames Company.
b. Cash Acme.
c. Conbraco Industries, Inc.
d. Watts Industries, Inc.; Water Products Division.
e. Zurn Plumbing Products Group; Wilkins Division.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome-plated.

B. Hose-Connection Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. MIFAB, Inc.
b. Watts Industries, Inc.; Water Products Div.
c. Conbraco Industries, Inc.
d. Zurn Plumbing Products Group; Wilkins Div.
e. Josam.
f. Chicago.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Ames Company.
b. Conbraco Industries, Inc.
c. Watts Industries, Inc.; Water Products Division.
d. Zurn Plumbing Products Group; Wilkins Division.
2. Standard: ASSE 1020.

3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
5. Accessories: Valves – Ball type, on inlet and outlet.

2.2 BALANCING VALVES

A. Memory-Stop Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. Watts.
h. Tour and Anderson.

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
4. Size: NPS 2 (DN 50) or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.3 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Individual-Fixture, Water Temperature Limiting Devices:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Watts.
b. Lawler Manufacturing Company, Inc.
c. Powers; a Watts Industries Co.

2. Standard: ASSE 1070, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: 105 deg F.
9. Tempered-Water Design Flow Rate: 1.5 gpm, or as indicated on the Drawings.

2.4 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 (DN 65) and larger.
3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
    a. Strainers NPS 2 (DN 50) and Smaller: 0.033 inch (0.84 mm) or 0.062 inch (1.57 mm).
    b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch (1.14 mm).
6. Drain: Factory-installed, hose-end ball-type drain valve.

2.5 HOSE BIBBS

A. Hose Bibbs:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Watts Drainage Products Inc.
    e. Chicago Faucet.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig (860 kPa).
8. Vacuum Breaker: Integral, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Finished Rooms: Operating key.
13. Include operating key with each operating-key hose bibb.
14. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.6 WALL HYDRANTS

A. Exterior Nonfreeze Wall Hydrants:
1. Basis of Design Product: Subject to compliance with requirements, provide Josam Hydrasan I, Model 7105, or comparable product by one of the following:
    a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    b. Watts Drainage Products Inc.
    c. Zurn Plumbing Products.
    d. Woodford Manufacturing Company.
2. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.

3. Pressure Rating: 125 psig (860 kPa).
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 (DN 20), female/NPS 1" (DN 25) male.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Outlet: Exposed, manual drain type, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
9. Nozzle and Wall-Plate Finish: Satin finish bronze.
10. Operating Keys(s): Two with each wall hydrant.
11. For the roof mounted equipment provide cold water union elbow assembly.

B. Interior Cold-Water Wall Hydrants:
1. Basis of Design Product: Subject to compliance with requirements, provide Josam Hydrasan I, Model 71020, or comparable product by one of the following:
   a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   b. Tyler Pipe; Wade Div.
   c. Watts Drainage Products Inc.
   d. Woodford Manufacturing Company.
   e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.21.3M for concealed or exposed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig (860 kPa).
4. Operation: Loose key.
5. Casings and Operating Rods: Of length required to match wall thickness. Include wall clamps.
6. Inlets: NPS 3/4 female, or NPS 1 male (DN 20 or DN 25).
7. Outlet: Concealed.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Vacuum Breaker: Nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052 and with garden-hose thread complying with ASME B1.20.7 on outlet.
11. Operating Keys(s): Two with each wall hydrant.

2.7 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy.
5. Ball: Stainless steel.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.8 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Watts Drainage Products.
   e. Zurn Plumbing Products.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.9 AIR VENTS

A. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig (1035-kPa) minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 (DN 15) minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.10 OUTLET BOXES:

A. CLOTHES WASHER OUTLET BOXES

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Acorn Engineering Company.
   b. Guy Gray Manufacturing Co., Inc.
   c. Symmons Industries, Inc.
   d. Watts Industries, Inc.; Water Products Div.
   e. Zurn Plumbing Products Group; Light Commercial Operation.

2. Mounting: Recessed.
3. Material and Finish: Enameled-steel or epoxy-painted-steelbox and faceplate.
4. Faucet: Combination, valved fitting or separate hot and cold water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS ½ (DN 15) glove, or ball valves and NPS ½ (DN 15) copper, water tubing.
6. Drain: NPS 2 (DN 50) standpipe and P-trap for direct waste connection to drainage piping.
7. Inlet Hoses: Two 60-inch (1500 mm) long, rubber household clothes washer inlet hoses with female, garden-hose-thread coupling. Include rubber washers.
8. Drain Hose: One 48-inch (1200 mm) long, rubber household clothes washer drain hose with hooked end.

B. ICEMAKER OUTLET BOXES:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Acorn Engineering Company.
   b. IPS Corporation.
   c. LSP Products Group, Inc.
   d. Oatey.
   e. Plastic Oddities; a division of Diverse Corporate Technologies.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS ½ (DN 15) or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS ½ (DN 15) globe or ball valve and NPS ½ (DN 15) copper, water tubing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.

D. Install water control valves with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.

E. Install balancing valves in locations where they can easily be adjusted.

F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

G. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve, and pump.

H. Install outlet boxes recessed in wall. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

I. Install water hammer arresters in water piping according to PDI-WH 201.

J. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Reduced-pressure-principle backflow preventers.
3. Double-check backflow-prevention assemblies.
4. Reduced-pressure-detector, fire-protection backflow-preventer assemblies.
5. Water pressure-reducing valves.
6. Calibrated balancing valves.
7. Primary, thermostatic, water mixing valves.
8. Primary water tempering valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 11 19

SECTION 221123 - DOMESTIC WATER PUMPS

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. In-line, sealless centrifugal pumps.

1.3 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

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.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 HORIZONTALLY MOUNTED, IN-LINE, SEPARATELY COUPLED CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide Bell & Gossett Domestic Pump; ITT Corporation or comparable product by one of the following:

1. TACO Incorporated.
2. Armstrong.
3. Wilo.

C. Description: Factory-assembled and -tested, in-line, all bronze construction, NSF 61 certified, single-stage, separately coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shafts mounted horizontal.

D. Pump Construction:

1. Casing: Radially split with threaded companion-flange connections for pumps with NPS 2 (DN 50) pipe connections and flanged connections for pumps with NPS 2-1/2 (DN 65) pipe connections.
2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
3. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
4. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
5. Bearings: Oil-lubricated; bronze-journal or ball type.
6. All bronze or stainless steel construction.
7. ECM motor.

E. Motor: Single speed, with grease-lubricated ball bearings; and rigidly mounted to pump casing.

F. Capacities and Characteristics:
1. Refer to drawings.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.3 CONTROLS

A. Thermostats: Electric; adjustable for control of hot-water re-circulation pump.

1. Type: Water-immersion temperature sensor, for installation in piping.
2. Range: 65 to 200 deg F (18 to 93 deg C)
3. Enclosure: NEMA 250, Type 4X
4. Operation of Pump: On or off.
5. Transformer: Provide if required.
6. Power Requirement: 120 V, ac.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.

C. Install horizontally mounted, in-line, separately coupled centrifugal pumps with shaft(s) horizontal.

D. Install vertically mounted, in-line, close-coupled centrifugal pumps with shaft vertical.

E. Pump Mounting: Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base usingrestrained spring isolators Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Minimum Deflection: 1/4 inch (6 mm).
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.

F. Install continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support pump weight.

1. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

G. Install thermostats in hot-water return piping.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
   1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
      a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
      b. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
   2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties."
   3. Install liquid filled pressure gage and snubber at suction of each pump and liquid filled pressure gage and snubber at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Section 220519 "Meters and Gages for Plumbing Piping."

D. Connect thermostats to pumps that they control.

3.4 IDENTIFICATION

A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 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. Check piping connections for tightness.
   3. Clean strainers on suction piping.
   4. Set thermostats for automatic starting and stopping operation of pumps.
   5. Perform the following startup checks for each pump before starting:
      a. Verify bearing lubrication.
      b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
      c. Verify that pump is rotating in the correct direction.
   6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
   7. Start motor.

8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.

3.6 ADJUSTING

A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 22 11 23

SECTION 221313 - SANITARY SEWERS

PART 1 - GENERAL

1.1. DESCRIPTION

A. The section includes furnishing of all labor, materials, tools, equipment, services and performing of all work necessary to complete the construction of sewers as herein specified to the lines and grades shown on the drawings, and as directed.

1.2. QUALITY ASSURANCE

A. Use all means necessary to protect the materials of this Section and to protect the installed work

B In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner at no additional cost to the Owner.

C. During the progress of the work, maintain an accurate record of the location of the piping with reference to job base lines, grades and elevations. Show all changes made in the piping layout and referenced distances from the centerline of the nearest manholes to installed structure drains.

D. The Contractor shall conduct a Line Acceptance Test using low-pressure air following the recommended practice for “Low-pressure Air Testing of Installed Sewer Pipe”; UNI-B-6-98 as published by Uni-Bell PVC Pipe Association dated July 1998 as amended.

E. The Contractor will retain testing and monitoring services of a Registered Professional Geotechnical Engineer, at the contractor’s expense to perform field and laboratory testing during sanitary sewer construction operations and to provide quality assurance of compliance with the Drawings and Specifications. Testing rates are to be determined by the Registered Professional Geotechnical Engineer to ensure certification of construction for acceptance by the governing agency. Three copies of testing reports are to be provided to the owner.

F. Upon completion of work for this section the Contractor will provide as-built surveys performed by a Licensed Land Surveyor or Engineer the as built is to ensure certification of construction for acceptance by the governing agency. Five copies of the as-builts are to be provided to the owner. If any structure is not in compliance with the design requirements the contractor will provide compliance at no additional cost to the Owner.

1.3. SUBMITTALS

A. The contractor is to provide the Owner with five (5) submittals for all materials covered under this section, and material certificates. Certificates are to be signed by Material Producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements. Manhole Manufacturing Drawing submittals are to prepared by a Maryland Registered Professional Engineer and provided by the contractor for approval by the engineer.

PART 2 - PRODUCTS

2.1. PIPE – STRUCTURES AND BEDDING

A. The gravity sewer pipe shall be manufactured in accordance with ASTM D-3034, SDR 35 specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings, utilizing a rubber ring joint.

B. Joints for both pipe and fittings shall be of the integral bell type, consisting of an integral wall section with a solid cross-section rubber ring, factory assembled and securely locked in place to prevent displacement and conform to ASTM D3212 and /or Uni-Bell Uni –B-1. Rubber gaskets shall comply in all respects with the physical requirements specified in ASTM F-477 and the lubricant used for joint assembly shall have not detrimental effect on the ring or pipe.

C. Pressure Sewer Piping, Fittings and Valves
a. All sanitary pressure sewer piping shall be of PVC (DR-18 or SDR-21), high density polyethylene (HDPE) pipe (DR-11) or ductile iron (DI) and fittings as hereinafter specified. (PVC) pipe and fittings shall be homogeneous throughout and free from visible discoloration cracks, bubbles, blisters, holes, foreign inclusions, cuts, or scrapes on inside or outside surfaces, or other imperfections which may impair the performance or life of the pipe. Polyvinyl Chloride Plastic Water Pipe 4 inch and larger shall be Class 150 (DR18) and shall meet the requirements of AWWA C900. PVC Water Pipe smaller than 4 inches shall be PVC 1120 (SDR21) and shall meet the requirements of ASTM D 2241. The outside diameters of DR18 shall be equivalent to cast-iron pipe. PVC Pipe shall have an integral bell with a rubber gasketed joint as listed in the AWWA C900 standard. Pipe and couplings shall be marked and factory tested in accordance with AWWA C900. (HDPE) pipe (DR11) or ductile iron (DI) and fittings as hereinafter specified. Pipe and fittings shall utilize heat fusion jointing. HDPE pipe shall be DR11 with outside diameters equivalent to cast iron pipe (DIPS). Heat fusion joining of HDPE pipe and fittings shall be done in accordance with ASTMF2620-11.
b. All valves shall be Ball Valve Curb Stop with Female Iron Pipe Thread (NPT) end connections. The valve size shall be same as the pipeline size. Connection to force main shall be packed joint with stainless steel insert, push-on joint or approved equal. Valves shall open left, counterclockwise and be suitable for the conveyance of wastewater. The ball valves shall turn one-quarter (1/4) turn, ninety degrees to open and shall have a minimum working pressure rating of 200 psi. The ball valve shall be suitable for buried service and shall be manufactured in accordance with AWWA C-500. Valve extension stems shall be manufactured with cold rolled steel and have a centering ring when depth of ball valve is greater than 6' - 0". Top of stem shall be compatible with a standard tee-head wrench and extend to a maximum of 3-feet below finished grade. Bottom of stem shall be compatible with the ball valve tee-head and pinned to top of valve.

D. Ductile iron pipe (DIP) and fittings shall conform to ANSI/AWWA C150/A21.50 in matters of design and ANSI AWWA C151/A21.51 for materials. Pipe thickness shall conform to Special Thickness Class 52. Pipe and fittings shall be cement lined and outside surface shall be bituminous coated.

E. Manholes: See contract drawings.

F. Manhole rim and covers are to be as indicated on contract drawings.

G. Bedding Stone is to be as stated on contract drawings.

H. Detector Tape shall be 3 inches wide (minimum) nonmetallic green plastic tape lettered sewer in black graphics.

I. Grinder Pump: See contract drawings. 24" Simplex 2HP Grinder Pump Model STH/Myers Package system with VS20-21-20.

PART 3 - EXECUTIONS

3.1. PIPE – STRUCTURES AND BEDDING

A. Each length of pipe shall be carefully inspected by the Contractor for possible defects before lying. The pipes shall be thoroughly cleaned before they are laid and shall be kept clean until the acceptance of the completed work. The upper ends of all pipe lines shall be provided with a carefully fitted stopper, which shall be used at all times, to prevent the entrance of dirt or other substances.

B. Pipe shall be carefully handled or lowered into the trench and laid true to line and grade. Bell holes shall be dug sufficiently large to ensure the making of proper joints and to provide a firm, solid bearing for the entire length of the pipe.

C. Special care shall be taken to ensure that each length shall abut against the next in such a manner that there shall be no shoulder or unevenness of any kind along the inside of the bottom half of the pipes as laid.

D. Structure and trench excavations and backfill are to be in accordance with Section 322000 Earthwork and Section 330500 Excavation, Backfill and Protection of Trenches.

E. Before joints are made, each pipe shall be well bedded on a solid foundation and no pipe shall be brought into position until the preceding length has been thoroughly embedded and secured in place. After pipes have been laid, there shall be no walking on or working over them, except such as may be necessary in tamping, until there is a covering at least two (2) feet in depth over their top. After joints have been made, the greatest care shall be used not to disturb or damage them during the refilling process, or at any other time. The Contractor's attention is directed to compaction requirements for haunch support of PVC pipe.

F. Proper and suitable tools and appliances for the safe and convenient handling and laying of pipes and fittings shall be used. Great care shall be taken to prevent the pipe lining and coating from being damaged, and any lining or coating damaged in any way shall be fully repaired by the Contractor at his own expense.

G. The excavations in which pipe is being laid shall be kept free from water. No water shall be allowed to rise over or run through the pipe while any joint is being made, nor until after it has thoroughly set. Any defects due to settlement shall be made good by the Contractor at his own expense.

H. Whenever a pipe requires cutting to fit into the line or to bring it to the required location, the work shall be done in a satisfactory manner so as to leave a smooth end, and without extra compensation.

I. When pipe is laid upon concrete piers or timber pipe supports, a true bearing surface shall be provided for the pipe so that the imposed load on pipe will be uniformly distributed to the entire area of the seat upon which it rests.

J. No pipe shall be laid upon a foundation into which frost has penetrated, nor at any time when there is danger of the formation of ice or the penetration of frost at the bottom of the excavation unless all precautions as to the minimum length of open trench and promptness of refilling are observed.

K. PVC pipe shall be installed in accordance with ASTM D-2321 "Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe" and the "Handbook of PVC Pipe" as published by the Uni-Bell Pipe Association.

L. Ductile Iron pipe (DIP) shall be installed in accordance with manufactures recommendations and the recommendations of the Ductile Iron Pipe Research Association.

M. Detector tape shall install 12” below the surface at final grade along all sewer mains.

N. All pipe, pipefitting, pipe plugs and other components shall be carefully examined and inspected for defects and any found imperfect will not be utilized in the work. If at any time before the final acceptance of the Contract, any defects are found in the sewer mains or its appurtenances the Contractor shall remove and replace the defective area. The Contractor, for any section of the sewer that fails any of the tests, shall take steps to eliminate the cause of failure. The correction of defects shall be done without extra compensation for the labor and material required even though such damage or failure may not have been due to any act, default or negligence on the part of the Contractor.

O. The Owner, upon completion and before backfill of any portion or all of the sanitary sewers under the Contractor will conduct a "Mirror Test" on all sewers for defects, alignment and grade. Mirror Test shall consist of reflecting light through the complete section of pipe, which in order to be accepted, shall be sufficiently true and straight in alignment to allow for the passage of the reflected sunlight. If over 1 inch of the complete section of pipe is not seen the pipe will be considered unacceptable and will need to be removed and replaced at the contractor’s expense.

P. Except as otherwise shown, approved manufactured plugs made especially to fit the bell of the size of pipe requiring a plug shall be installed at the ends of all pipe including manhole stubs as soon as these pipe ends are installed to prevent earth, water and foreign matter from entering the sanitary sewer system. In addition, approved manufactured temporary plugs shall be installed on all sewer lines at the end of each day's work or at the ends of incomplete lines where work is temporarily discontinued for any reason. Brick masonry bulkheads shall be constructed where shown on the drawings or as directed.

Q. The Contractor, will order tests to be made on all portions of the sewers built under the Contract. The Contractor shall furnish all work necessary to perform the tests

as specified herein and as directed. All tests shall be made before any connections are allowed. The Contractor shall securely plug all house connections during all testing.

R. All sewers before they are tested shall be carefully plugged and backfilled to a depth of not less than two (2) feet above the top of the sewer. The contractor is to conduct Line Acceptance Tests using low pressure air tests following the practice for “Low-Pressure Air Testing of Installed Sewer Pipe”, UNI-B-6 as published by Uni-Bell PVC Pipe Association. Tests are to be documented by the contractor on Air Test Data Sheets Uni-B-6-98, and are to be performed under the observance of the owner’s inspector. The owner is to be notified at least 3 days prior to the scheduled tests.

S. The Contractor shall replace or repair all visible leaks and defects on all sections of sewer failing to meet the air tests at no expense to the owner.

T. All costs in connection with the tests and retests specified shall be borne by the Contractor.

U. Each pipe run between manholes is to be inspected for vertical and horizontal deflection prior to testing. If deflections are observed during inspection as stated in item N above the pipe run will be removed and reinstalled by the contractor at no expense to the Owner.

END OF SECTION

SECTION 221316 - SANITARY WASTE AND VENT 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. This Section includes the following for soil, waste, and vent piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.
3. Encasement for underground metal piping.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. LLDPE: Linear, low-density polyethylene plastic.

D. NBR: Acrylonitrile-butadiene rubber.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: (Type DWV) ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

B. Solvent Cement and Adhesive Primer:

1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 HUB-LESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.

C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Heavy-Duty, Husky Type, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

a. Available Manufacturers:

1) ANACO.
2) Clamp-All Corp.
3) Ideal Div.; Stant Corp.
4) Mission Rubber Co.
5) Tyler Pipe; Soil Pipe Div.
6) Charlott.

D. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

a. ANACO.

2.5 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

2. Copper Condensate Drain Piping: Type L, drawn copper tubing, wrought copper fittings and soldered joints.

2.6 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
   a. Fernco, Inc.
   b. Logan Clay Products Company (The).
   c. NDS, Inc.
   d. Plastic Oddities, Inc.

2. Sleeve Materials:
   a. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   b. For cast iron soil pipes: ASTM C564 rubber.
   c. For dissimilar pipes: ASTM D 1460, elastomeric or rubber sleeve with full length, corrosion-resistant outer shield and corrosion-resistant metal tension band and tightening mechanism on each end.

B. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:

a. EBAA Iron Sales, Inc.
b. Romac Industries, Inc.
c. Star Pipe Products; Star Fittings Div.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil and waste piping shall be the following:
1. Hubless cast iron soil pipe and fittings; heavy duty (husky) shielded stainless steel couplings and hubless coupling joints.

C. Aboveground, vent piping shall be the following:
1. Hubless cast iron soil pipe and fittings; heavy duty (husky) shielded stainless steel couplings and hubless coupling joints.

D. Underground, soil, waste, and vent piping NPS 6 and smaller shall be the following:
1. Solid wall, Sewer and Drain Series, Schedule 40, PVC pipe; PVC socket fittings; and solvent-cemented joints except for kitchen.
2. Service class cast iron soil piping with gasketed or caulked joints for all kitchen sanitary lines connected to the grease trap.

E. Above-ground, soil, and waste and vent piping located over the kitchen, cafeteria/dining area (including ancillary spaces) and other food preparation/eating areas shall be the following:
1. Copper DWV tube, copper drainage fittings and soldered joints.

F. All Condensate Drain Piping:
1. Type L, drawn copper tubing with wrought copper fittings and soldered joints.

3.3 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

C. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and fittings Handbook" Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

D. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not

change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

E. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

F. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

G. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

H. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

I. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

K. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

L. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

M. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

C. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

D. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 VALVE INSTALLATION

A. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

B. Backwater Valves: Install backwater valves in piping subject to sewage backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated. Provide full-sized manhole to grade/finished floor.
2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Backwater valve are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.

F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.

2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.

H. Install supports for vertical copper tubing every 10 feet (3 m).

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping 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 piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 13 16

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

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 sanitary drainage piping specialties:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Trench drains.
5. Roof flashing assemblies.
6. Through-penetration firestop assemblies.
7. Miscellaneous sanitary drainage piping specialties.
8. Flashing materials.

B. Related Sections include the following:

1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

1. Drains.

2. Backwater valves.
3. Solids Interceptors.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.14.1.
3. Size: Same as connected piping.
4. Body: Cast iron.
5. Cover: Cast iron with bolted access check valve.
6. End Connections: Hubless.
7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Horizontal, PVC Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Rectorseal or as approved equal.

2. Size: Same as connected piping.
3. Body: PVC.
4. Cover: PVC with screwed access to check valve.
5. End Connections: Glued.
6. Type Check Valve: Removable, PVC, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
7. Extension: PVC, soil-pipe extension to field-installed cleanout at floor.

C. Drain-Outlet Backwater Valves:

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 following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
c. Watts Drainage Products Inc.
d. Zurn Plumbing Products Group; Specification Drainage Operation.

3. Size: Same as floor drain outlet.
4. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
5. Check Valve: Removable ball float.
6. Inlet: Threaded.
7. Outlet: Threaded or spigot.

2.2 CLEANOUTS

A. Exposed Metal Cleanouts – Unfinished areas:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 4228 Series or a comparable product by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.
g. Josam Company; Blucher-Josam Div.

2. Standard: ASME A112.3.1 for stainless steel for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Stainless-steel tee with side cleanout as required to match connected piping.
5. Closure: Countersunk brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith Series 4188C (terrazzo-recessed); Series 4168C (composition tile – recessed); Series

4048C (ceramic tile – non-recessed); Series 4026C-Y (carpet with clean-out marker) or a comparable product by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Tyler Pipe; Wade Div.
d. Watts Drainage Products Inc.
e. Zurn Plumbing Products Group.

2. Standard: ASME A112.36.2M for cast-iron soil pipe with cast-iron ferrule cleanout.
3. Size: Same as connected branch.
4. Type: Cast-iron soil pipe with cast-iron ferrule.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round, Square, or as determined by floor type.
12. Flashing Flange: Required
13. Flashing Clamp: Required
14. Top Loading Classification: Heavy Duty.
15. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Wall Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith Series 5432 (unfinished areas, Series 4558 (plaster/drywall) and Series 4532 (tile/CMU) or a comparable product by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Tyler Pipe; Wade Div.
d. Watts Drainage Products Inc.
e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Square, stainless-steel wall-installation frame and cover. Refer to Series type.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains – FD-A:

1. Basis-of-Design Product: Subject to compliance with requirements, provide J. R. Smith Series 2230 or a comparable product by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Tyler Pipe; Wade Div.
d. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Not required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Slotted sediment bucket.
12. Top or Strainer Material: Galvanized cast iron.
13. Top Shape: Round.
14. Dimensions of Top or Strainer: 12” Round**.**
15. Top Loading Classification: Medium Duty.
16. Funnel: Required, where receiving piped waste.
17. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet.
18. Trap Material: Cast iron.
19. Trap Pattern: Deep-seal P-trap.
20. Trap Features: Trap-Guard

B. Cast-Iron Floor Drains – FD-B:

1. Basis-of-Design Product: Subject to compliance with requirements, provide J. R. Smith Series 2005 or a comparable product by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Not required.
12. Top or Strainer Material: Nickel bronze.
13. Top of Body and Strainer Finish: Nickel bronze.
14. Top Shape: Round; or square where installed in tile floors.
15. Dimensions of Top or Strainer:
16. Funnel: Not required.
17. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet.
18. Trap Material: Not required.
19. Trap Pattern: Deep-seal P-trap.
20. Trap Features: Trap Guard.

C. Cast-Iron Floor Sinks – FS:

1. Basis-of-Design Product: Subject to compliance with requirements, provide J. R. Smith Series 3151Y or a comparable product by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor sink sanitary drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Flashing Clamp: Required for Altro Vinyl Traffic Flooring.
9. Outlet: Bottom.
10. Backwater Valve: Not required.
11. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
12. Sediment Bucket: Required, aluminum slotted sediment bucket.
13. Top or Strainer Material: Nickel bronze.
14. Top of Body and Strainer Finish: Nickel bronze.
15. Top Shape: Square.
16. Dimensions of Top or Strainer: 12-1/2-inch top nickel bronze rim with 1/2 grate. Eight-inch deep receptor. Coordinate requirements with the food service contractor and authorities having jurisdiction.
17. Funnel: Not required.
18. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet.
19. Trap Material: Not required.
20. Trap Pattern: Deep-seal P-trap.
21. Trap Features: Trap-Guard.

2.4 TRENCH DRAIN – TD-A

A. Plastic Channel Drainage Systems:

1. Basis-of-Design Product: Subject to compliance with requirements, provide J.R. Smith Enviro-Flo Series 9930 with load Class A light Duty Grate Series 9870-451-SSPA, or a comparable product by one of the following:

   a. Zurn Plumbing Products Group; Flo-Thru Operation.
   b. Josam Company.

2. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.

   a. Channel Sections: Interlocking-joint, HDPE or PE, modular units, with end caps. Include flat, rounded, or inclined bottom, with level invert and with outlets in number, sizes, and locations indicated. Dimensions: 4 inches (102 mm) wide. Include number of units required to form total lengths indicated.
   b. Grates: With perforations and widths and thickness that fit recesses in channel sections. Material: Perforated stainless steel with quick-lock assembly.
   c. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
   d. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.5 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Acorn Engineering Company; Elmdor/Stoneman Div.
   b. Thaler Metal Industries Ltd.
   c. All American Metal Products, Inc.

B. Description: EPDM base seal and skirt extending at least 18 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting. Provide 20-year warranty against leaks, condensation, and defects in materials and/or manufacturing.

C. Roof flashing shall be installed by the Roofing Contractor.

2.6 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

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 following:

   a. ProSet Systems Inc.

2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.7 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains – (OHD):

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.
3. Open hub drain shall be Josam 67100A Series coated cast iron with ball float, 1-1/2” trap priming connection, or comparable product of J.R. Smith, Zurn, or WaDE.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

   a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
   b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

C. Floor-Drain, Trap-Guard:

1. Description: Trap guards shall be ProVent Systems, Pro Set trap guard, ASSE 1072 approved test for ANSI / ASME A11.2.6.3 drains.
2. Size: Same as floor drain outlet. Refer to manufacture for sizing.

D. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches (51 mm) above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.8 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm) thickness.
2. Vent Pipe Flashing: 8 oz./sq. ft. (2.5 kg/sq. m or 0.27-mm) thickness.

B. Roof flashing shall be installed by the Roofing Contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate at base of each vertical soil and waste stack.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
    a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
    b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
    c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

G. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

H. Assemble and install ASME A112.3.1, stainless-steel channel drainage systems according to ASME A112.3.1. Install on support devices so that top will be flush with surface.

I. Assemble non-ASME A112.3.1, stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

J. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

K. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

L. Install fixture air-admittance valves on fixture drain piping.

M. Install stack air-admittance valves at top of stack vent and vent stack piping.

N. Install air-admittance-valve wall boxes recessed in wall.

O. The Roofing Contractor shall install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

P. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

Q. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

R. Assemble open drain fittings and install with top of hub 2 inches (51 mm) above floor.

S. Install deep-seal traps on floor drains and other waste outlets.

T. Install floor-drain, trap guard on inlet to floor drains.

U. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

V. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

W. Install vent caps on each vent pipe passing through roof.

X. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.

Y. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

Z. Install wood-blocking reinforcement for wall-mounting-type specialties.

AA. Install traps with trap guards on plumbing specialty drain outlets.

BB. Install Trap Guards on all drains (open hub drains, floor drains, etc.). Trap priming is not required for drains with Trap Guards installed.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION (by Roofing Contractor)

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Solids interceptors.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19

SECTION 22 14 13 - FACILITY STORM DRAINAGE 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. This Section includes the following storm drainage piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

E. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water (30 kPa).
2. Storm Drainage, Force-Main Piping: 50 psig (345 kPa).

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. Solvent Cement and Adhesive Primer:

1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 HUBLESS CAST IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

a. Available Manufacturers:

1) ANACO.
2) Clamp-All Corp.
3) Ideal Div.; Stant Corp.
4) Mission Rubber Co.
5) Tyler Pipe; Soil Pipe Div.
6) Charlotte.

C. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

a. ANACO, or equal.

2.5 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast-copper or ASME B16.29, wrought-copper, solder-joint fittings.

B. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

C. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2.6 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Dallas Specialty & Mfg. Co.
b. Fernco, Inc.
c. Logan Clay Products Company (The).

2. Sleeve Materials:
a. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
b. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Mission Rubber Co.

C. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Dresser, Inc.; DMD Div.
c. EBAA Iron Sales, Inc.
d. Ford Meter Box Company, Inc. (The); Pipe Products Div.
e. JCM Industries, Inc.
f. Romac Industries, Inc.
g. Smith-Blair, Inc.
h. Viking Johnson.

2. Gasket Material: Natural or synthetic rubber.
3. Metal Component Finish: Corrosion-resistant coating or material.

D. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:

a. EBAA Iron Sales, Inc.
b. Romac Industries, Inc.
c. Star Pipe Products; Star Fittings Div.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground storm drainage piping shall be the following:
1. Hubless cast iron soil pipe and fittings; heavy duty (husky) shielded stainless steel couplings and hubless coupling joints.
2. Dissimilar pipe material couplings: Rigid, unshielded non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

C. Underground storm drainage piping shall be the following:
1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

D. Aboveground storm drainage force mains shall be the following:

1. Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.

3.3 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."

D. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

F. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

G. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

H. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:

1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 2 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

I. Install force mains at elevations indicated.

J. Install PVC storm drainage piping according to ASTM D 2665.

K. Install underground PVC storm drainage piping according to ASTM D 2321.

L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Common Work Results for Plumbing."

N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Common Work Results for Plumbing."

O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Common Work Results for Plumbing."

P. Install cast iron storm drainage piping for all above ground locations.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

C. Hubless cast iron soil piping coupled joints; Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and fittings Handbook" for hubless-coupling joints.

D. Soldered joints: Use ASTM B 813, water flushable, lead-free flux; ASTM B32, lead-free alloy solder; and ASTM B828 procedure, unless otherwise indicated.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves: Install shutoff valve on each sump pump discharge.

1. Install full-port ball valve for piping NPS 2 (DN 50) and smaller.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
2. Install backwater valves in accessible locations.
3. Backwater valve are specified in Division 22 Section "Storm Drainage Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.

H. Install supports for vertical copper tubing every 10 feet (3 m).

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

D. Connect force-main piping to the following:
1. Sump Pumps: To sump pump discharge.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping 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 piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 14 13

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

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. Roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.
4. Backwater valves.
5. Trench drains.
6. Through-penetration firestop assemblies.
7. Flashing materials.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, Large-Sump, General-Purpose Roof Drains: RD

1. Manufacturers: Basis of Design Product: Subject to compliance with requirements, provide Jay R. Smith Series 1010 or comparable product by one of the following:

   a. Josam Company.
   b. Tyler Pipe; Wade Div.
   c. Zurn Plumbing Products.

2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 15-1/4” diameter.
5. Combination Flashing Ring and Gravel Stop: Required.

6. Flow-Control Weirs: Not required.
7. Outlet: Bottom.
8. Extension Collars: Required.
9. Underdeck Clamp: Required.
10. Expansion Joint: Not required.
11. Sump Receiver Plate: Required.
12. Dome Material: Galvanized cast iron.
13. Perforated Gravel Guard: Stainless Steel.
14. Vandal-Proof Dome: Required.
15. Water Dam: Not required.

B. Cast-Iron, Overflow Drains: OD

1. Manufacturers: Basis of Design Product: Subject to compliance with requirements, provide Jay R. Smith Series 1070 or comparable product by one of the following:

   a. Josam Company.
   b. Tyler Pipe; Wade Div.
   c. Zurn Plumbing Products.

2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 15-1/4” diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Flow-Control Weirs: Not required.
7. Outlet: Bottom.
8. Extension Collars: Required.
9. Underdeck Clamp: Required.
10. Expansion Joint: Not required.
11. Sump Receiver Plate: Required.
12. Dome Material: Galvanized cast iron.
13. Perforated Gravel Guard: Not Required.
14. Vandal-Proof Dome: Required.
15. Water Dam: Not required.
16. Overflow Standpipe: Required. Field cut to proper height.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Conductor Nozzles:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

B. Downspout Adaptors:

1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
2. Size: Inlet size to match parapet drain outlet.

C. Downspout Boots:

1. Description: Manufactured, heavy duty 14-gauge type 304 stainless steel, with strap or ears for attaching to building; NPS 4 (DN 100) outlet; and shop-applied powder coating.
2. Manufacturers: Basis of design Piedmont Model SV or as approved equal

3. Size: Inlet size to match downspout and NPS 4 (DN 100) outlet.
4. Color Custom color selected by architect.
5. Cleanout: Provide cleanout.

2.3 CLEANOUTS

A. Floor Cleanouts:

1. Basis of Design Product: Subject to the compliance with requirements, provide Jay R. Smith Series 4188C (terrazzo-recessed), Series 4168C (composition tile –recessed), Series 4048C (Ceramic tile –Non-recessed), and Series 40266-Y (carpet with clean-out marker0 or comparable products of one of the following:

    a. Josam Company.
    b. Smith, Jay R. Mfg. Co.
    c. Mifab, Inc..
    d. Zurn Plumbing Products Group; Specification Drainage Operation.
    e. Wade.
    f. Watts Water Technologies, Inc.

2. Standard: ASME A112.36.2M, cast iron soil pipe with cast iron ferrule.
3. Size: Same as connected branch.
4. Type: Cast iron soil pipe with cast iron ferrule.
5. Body or Ferrule Material: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round or square as determined by floor type.
12. Top-Loading Classification: Light Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

B. Test Tees :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.
    d. Watts Water Technologies, Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.
    f. Wade.

2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
3. Size: Same as connected drainage piping.
4. Body Material: Cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts:

1. Basis of Design Product: Subject to compliance with requirements, provide Jay R. Smith Series 5432 (unfinished areas), Series 4558 plaster/drywall) and Series 4532 (tile and CMU) or comparable product of one of the following:

    a. Josam Company.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.
    d. Wade.
    e. Watts Water Technologies, Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
3. Size: Same as connected drainage piping.
4. Body Material: Hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure: Countersunk brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw. Refer to Series type.
8. Wall Access: Square stainless steel wall installation frame and cover.

2.4 BACKWATER VALVES

A. Cast-Iron, Horizontal Backwater Valves :

1. Basis of Design Product: Subject to compliance with requirements, provide Jay R. Smith Series 7022S or comparable product of one of the following:

    a. Josam Company.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.
    d. Watts Water Technologies, Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.14.1, for backwater valves.
3. Size: Same as connected piping.
4. Body Material: Cast iron.
5. Cover: Cast iron with bolted access check valve.
6. End Connections: hubless.
7. Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed.
8. Extension: ASTM A 74, Service class; full-size, cast-iron soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Horizontal, PVC Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Rectorseal or as approved equal.

2. Size: Same as connected piping.
3. Body: PVC.
4. Cover: PVC with screwed access to check valve.
5. End Connections: Glued.

6. Type Check Valve: Removable, PVC, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
7. Extension: PVC, soil-pipe extension to field-installed cleanout at floor.

C. Cast-Iron, Drain-Outlet Backwater Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 7080 Series or comparable product by one of the following:

a. Josam Company.
b. Smith, Jay R. Mfg. Co.
c. Watts Water Technologies, Inc.
d. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Size: Same as floor drain or no huboutlet.
3. Body Material: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
4. Check Valve: Removable ball float.
5. Inlet: Threaded.
6. Outlet: Threaded or spigot.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

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. ProSet Systems Inc.

2. Standard: ASTM E 814, for through-penetration firestop assemblies.
3. Certification and Listing: Intertek Testing Service NA for through-penetration firestop assemblies.
4. Size: Same as connected pipe.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.

2.6 FLASHING MATERIALS (by Roofing Contractor)

A. Copper Sheet: ASTM B 152/B 152M, 1203/sq.ft.

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40 mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07 Sections.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.
4. Coordinate installation with the Roofing Contractor.

B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.

C. Install downspout boots at grade with top a minimum of 18 inches (Refer to Architectural Drawings) above grade. Secure to building wall.

D. Install conductor nozzles at exposed end of conductors where they spill onto grade.

E. Install cleanouts in aboveground piping and building drain piping according to the International Plumbing Code, and where indicated.

1. Use cleanouts the same size as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate cleanouts at base of each vertical soil and waste stack.

F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

H. Install horizontal backwater valves in floor with cover flush with floor.

I. Install drain-outlet backwater valves in outlet of drains.

J. Install test tees in vertical conductors and near floor.

K. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

L. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.

M. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

N. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.

O. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION (by Roofing Contractor)

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. (30-kg/sq. m) lead sheets. Solder joints of 4.0-lb/sq. ft. (20-kg/sq. m) lead sheets, 0.0625-inch (1.6-mm) thickness or thinner.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches (250 mm) and with skirt or flange extending at least 8 inches (200 mm) around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 14 23

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.

1.2 SUMMARY

A. Section Includes:

1. Commercial, light-duty, storage, electric, domestic-water heaters.
2. Domestic-water heater accessories.

1.3 SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

C. Product Certificates: For each type of commercial and tankless, electric, domestic-water heater, from manufacturer.

D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

E. Source quality-control reports.

F. Field quality-control reports.

G. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

H. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

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.

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
    a. Structural failures including storage tank and supports.
    b. Faulty operation of controls.
    c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Periods: From date of Substantial Completion.
    a. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
        1) Storage Tank: Ten years.
        2) Controls and Other Components: Two years.
    b. Electric, Tankless, Domestic-Water Heaters: Two (2) year(s).
    c. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    a. Bradford White Corporation.
    b. Lochinvar Corporation.
    c. Rheem Manufacturing Company.
    d. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
    e. State Industries.
2. Standard: UL 174.
3. Storage-Tank Construction: Steel, vertical arrangement.
    a. Tappings: ASME B1.20.1 pipe thread.
    b. Pressure Rating: 150 psig (1035 kPa).
    c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

4. Factory-Installed Storage-Tank Appurtenances:

   a. Anode Rod: Replaceable magnesium.
   b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
   c. Drain Valve: ASSE 1005.
   d. Insulation: Comply with ASHRAE/IESNA 90.1.
   e. Jacket: Steel with enameled finish.
   f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
   g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation unless otherwise indicated. Limited to 12 kW total.
   h. Temperature Control: Adjustable thermostat.
   i. Safety Control: High-temperature-limit cutoff device or system.
   j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

5. Special Requirements: NSF 5 construction with legs for off-floor installation.

B. Capacity and Characteristics: Refer to drawings.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AMTROL Inc.
   b. Flexcon Industries.
   c. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
   d. State Industries.
   e. Taco, Inc.

2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:

   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
   b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.

4. Capacity and Characteristics:

   a. Working-Pressure Rating: 150 psig (1035 kPa).
   b. Capacity Acceptable: 4 gal. (15.1 L) minimum.
   c. Air Precharge Pressure: 25 psig.

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 (DN 20) with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

D. Heat-Trap Fittings: ASHRAE 90.2.

E. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-type shutoff valves to isolate each domestic-water heater and memory-stop balancing valves to provide balanced flow through each domestic-water heater.

1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
2. Comply with requirements for balancing valves specified in Division 22 Section "Domestic Water Piping Specialties."

F. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- (172.5-kPa-) maximum outlet pressure unless otherwise indicated.

G. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

H. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

I. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

J. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

K. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches (457 mm) above the floor.

L. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Division 03.

1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Division 22 Section "Domestic Water Piping Specialties."

F. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Division 22 Section "Meters and Gages for Plumbing Piping."

G. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Division 22 Section "Meters and Gages for Plumbing Piping."

H. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping," and comply with requirements for thermometers specified in Division 22 Section "Meters and Gages for Plumbing Piping."

I. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25 psig (172 kPa). Comply with requirements for pressure-reducing valves and water hammer arresters specified in Division 22 Section "Domestic Water Piping Specialties."

J. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

K. Fill electric, domestic-water heaters with water.

L. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, domestic-water heaters.

END OF SECTION 223300

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:

1. Lavatory Faucets.
2. Sink Faucets.
3. Flushometers.
4. Toilet seats.
5. Protective shielding guards.
6. Fixture supports.
7. Water closets.
8. Lavatories.
9. Mop Sinks.
10. Sinks.

B. Related Sections include the following:

1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
3. Division 22 Section "Drinking Fountains and Water Coolers."
4. Division 31 Section "Facility Water Distribution Piping" for exterior plumbing fixtures and hydrants.

1.2 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, cast-iron fixtures: ASME A112.19.1M.
2. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
3. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
4. Vitreous-China Fixtures: ASME A112.19.2M.
5. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME.A112.18.3M.
2. Faucets: ASME A112.18.1.
3. Hose-Connection Vacuum Breakers: ASSE 1011.
4. Hose-Coupling Threads: ASME B1.20.7.
5. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
6. NSF Potable-Water Materials: NSF 61.
7. Pipe Threads: ASME B1.20.1.
8. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
9. Supply Fittings: ASME A112.18.1.
10. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for shower faucets:

1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
3. Faucets: ASME A112.18.1.
4. Hand-Held Showers: ASSE 1014.
5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
6. Hose Coupling Threads: ASME B1.20.7.
7. Manual-Control Antiscald Faucets: ASTM F 444.
8. Pipe Threads: ASME B1.20.1.
9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
10. Thermostatic-Control Antiscald Faucets: ASTM F444 and ASSE 1016.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F 409.
6. Brass Waste Fittings: ASME A112.18.2.
7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Disposers: ASSE 1008 and UL 430.
2. Dishwasher Air Gap Fittings: ASSE 1021.
3. Flexible Water Connectors: ASME A112.18.6.
4. Floor Drains: ASME A112.6.3.
5. Grab Bars: ASTM F 446.
6. Hose Coupling Threads: ASME B1.20.7.
7. Off-Floor Fixture Supports: ASME A112.6.1M.
8. Pipe Threads: ASME B1.20.1.
9. Plastic Toilet Seats: ANSI Z124.5.
10. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 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. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 2 of each type.
4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
5. Waterless Urinal Cartridges: Equal to 10 percent of amount of each type installed.
6. Toilet Seats: Equal to 5% of amount of each type installed.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets, LF-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Chicago Faucet 405-E64VP665AB or a comparable product by one of the following:

a. American Standard
b. Zurn
c. Moen

2. Description: Manual, deck mounted metering solid-brass valve. Coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

a. Body Type: Three hole, 8” centers.
b. Body Material: Commercial, solid brass.
c. Finish: Polished chrome plated.
d. Maximum Flow Rate: 1.0 gpm (3.8L/min.), unless otherwise indicated.
e. Mounting: Deck, concealed.
f. Valve Handles: 1¾” Vandal Proof Push Button Self Closing, auto timed meter cartridge, adjustable run time 2-25 seconds.
g. Spout: Rigid type, 5” minimum center to center, angled water outlet, vandal proof, pressure compensating laminar flow non-aerating outlet.
h. Inlet(s): NPS 1/2 (DN 15) male shank.

2.2 SINK FAUCETS

A. Sink Faucets, SF-1:

1. Basis of Design Product: Subject to compliance with requirements, provide Chicago Faucet Model 540-LD897SWXFCP or a comparable product by one of the following:

a. Bradley Corporation.
b. Delta Faucet Company.
c. Kohler Co.
d. Moen, Inc.

e. T&S Brass and Bronze Works, Inc.
f. Zurn Plumbing Products Group; Commercial brass Operation.

2. Description: Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot-and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.
c. Maximum Flow Rate: 2.5 gpm (9.5 L/min.), unless otherwise indicated.
d. Mixing Valve: Two-lever handle.
e. Backflow Protection Device for Hose Outlet: Required.
f. Centers: 8 inches (203 mm).
g. Mounting: Back/wall, exposed.
h. Handle(s): Lever.
i. Inlet(s): NPS 1/2 (DN 15) male shank.
j. Spout Type: Rigid, solid brass with wall brace.
k. Spout Outlet: Hose thread.
l. Vacuum Breaker: Required.
m. Operation: Compression, manual.
n. Drain: Grid.

B. Sink Faucets, SF-2:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Chicago Faucet Model 895-317E73-RGD2AB or a comparable product by one of the following:

a. Bradley Corporation.
b. Delta Faucet Company.
c. Kohler Co.
d. Moen, Inc.
e. T&SD Brass and Bronze Works, Inc.
f. Zurn Plumbing Products Group; Commercial brass Operation.

2. Description: Sink faucet, three-hole fixture. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.
c. Maximum Flow Rate: 1.0 gpm (3.8L/min.), unless otherwise indicated.
d. Mixing Valve: Two-lever handle.
e. Backflow Protection Device for Hose Outlet: Not required.
f. Centers: 4 inches (102 mm).
g. Mounting: Deck, concealed.
h. Handle(s): Wristblade.
i. Inlet(s): NPS 1/2 (DN 15) male shank.
j. Spout Type: 5-1/4” Restricted swing gooseneck.
k. Spout Outlet: Non-aerating laminar outlet.
l. Vacuum Breaker: Not required.
m. Operation: Compression, manual.
n. Drain: Grid.

C. Sink Faucets, SF-3

1. Basis-of-Design Product: Subject to compliance with requirements, provie Chicago Faucet Model 523-317ABCP or a comparable product by one of the following:

a. Bradley Corporation.

b. Delta Faucet Company.
c. Kohler Co.
d. Moen, Inc.
e. T&SD Brass and Bronze Works, Inc.
f. Zurn Plumbing Products Group; Commercial brass Operation.

2. Description: Pre-rinse fitting with adjustable arms. Include hot-and-cold water indicators; coordinate faucet inlet with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.
c. Maximum Flow Rate: 1.0 gpm.
d. Mixing Valve: Two-lever handle.
e. Backflow Protection Device for Hose Outlet: Not required.
f. Centers: 7-1/4" – 8-3/4". Coordinate with fixture.
g. Mounting: Wall with adjustable arms..
h. Handle(s): Wristblade.
i. Inlet(s): NPS 1/2 (DN 15) male shank.
j. Spout Type: Mini pre-rinse with pipe strap and hook assembly.
k. Spout Outlet: Water conserving pre-rinse.
l. Vacuum Breaker: Not required.
m. Operation: Compression, manual.
n. Drain: Grid.

2.3 FLUSHOMETERS

A. Water Closet Flushometers, FV-1 (P1, P1A):

1. Basis of Design Product: Subject to compliance with requirements, provide Sloan Royal 111, 1.6GPH manual-operated flush valve

a. American Standard
b. Zurn

2. Description: Flushometer for water-closet-type fixture shall be Sloan Royal 111 Dual Flush (1.6 gpf down) manual-operated flush valve. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

a. Internal Design: Diaphragm operation.
b. Style: Exposed.
c. Inlet Size: NPS 1 (DN 25).
d. Trip Mechanism: Lever.
e. Consumption: 1.6 gpf.
f. Tail Piece: NPS 1-1/2" (DN 40) and standard length to top of bowl.

B. Urinal Flushometers, FV-2 (P2, P2A):

1. Basis of Design Product: Subject to compliance with requirements, provide Sloan Royal 186-0.125, manual-operated flush valve, or a comparable product by one of the following:

a. American Standard
b. Zurn

2. Description: Flushometer for water-closet-type fixture shall be Sloan Royal 111-1.28, manual-operated flush valve. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

a. Internal Design: Diaphragm operation.
b. Style: Exposed.
c. Inlet Size: NPS ¾" (DN 20).
d. Trip Mechanism: Lever.
e. Consumption: 0.125 gpf.
f. Tail Piece: NPS 1" (DN 25) and standard length to top of bowl.

2.4 TOILET SEATS

A. Toilet Seats, TS-1:

1. Basis of Design Product: Subject to compliance with requirements, provide Church Model 9500SSC or a comparable product by one of the following:

a. Bemis Manufacturing Company.
b. Olsonite Corp.

2. Description: Toilet seat for water-closet-type fixture.

a. Material: Molded, solid plastic with antimicrobial agent.
b. Configuration: Open front without cover.
c. Size: Elongated.
d. Hinge Type: SS with external check.
e. Class: Heavy Duty Commercial.
f. Color: White.

2.5 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Engineered Brass Co.
b. McGuire Manufacturing Co., Inc.
c. TRUEBRO, Inc.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.6 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe: Wade Div.

B. Water Closet Supports:

1. Description: Combination carrier designed for accessible/standard mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

C. Urinal Supports:

1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Lavatory Supports:

1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

2.7 WATER CLOSETS

A. Water Closets, P-1:

1. Manufacturers: Basis of Design Product: Subject to Compliance with requirements, provide American Standard Afwall Millennium FloWise, or a comparable product of one of the following:

   a. Kohler Company.
   b. Sloan.

2. Description: Wall-mounted, back outlet, vitreous-china fixture designed for flushometer valve operation.

   a. Style: Flushometer valve.
   b. Supply: NPS 1” chrome-plated brass or copper with screwdriver stop.
      1) Bowl Type: Elongated high efficiency toilet (HET). Include bolt caps matching fixture.
      2) Design Consumption: 1.6 gpf.
      3) Color: White.
      4) Height: Standard Adult (Refer to architectural drawings)
   c. Flushometer: F-1
   d. Toilet Seat: TS-1

B. Water Closets, P-1A (ADA):

1. Manufacturers: Basis of Design Product: Subject to Compliance with requirements, provide American Standard Afwall Millennium FloWise or a comparable product of one of the following:

   a. Kohler Company.
   b. Sloan.

2. Description: Accessible, wall-mounted, back outlet, vitreous-china fixture designed for flushometer valve operation.

   a. Style: Flushometer valve.
   b. Supply: NPS 1” chrome-plated brass or copper with screwdriver stop.

1) Bowl Type: Elongated with siphon-jet design.
2) Design Consumption: 1.6 gpf.
3) Color: White.
4) Height: Accessible Adult (Refer to architectural drawings)

c. Flushometer: F-1
d. Toilet Seat: TS-1.

2.8 URINALS

A. Urinals, P2:

1. Manufacturers: Basis of Design Product: Subject to Compliance with requirements, provide American Standard Washbrook FloWise, or a comparable product of one of the following:

a. Kohler Company.
b. Sloan.

2. Description: Wall-mounting, back-outlet, vitreous-china fixture.

a. Type: Ultra High Efficiency, Low Consumption.
b. Color: White.
c. Outlet Size: NPS 2 (DN 50).
d. Fixture Support: Urinal: J.R. Smith Model 0637M.
e. Height: Standard (Refer to architectural drawings)
f. Flushometer: FV-2

B. Urinals, P2A (ADA):

1. Manufacturers: Basis of Design Product: Subject to Compliance with requirements, provide American Standard Washbrook FloWise, or a comparable product of one of the following:

a. Kohler Company.
b. Sloan.

2. Description: Wall-mounting, back-outlet, vitreous-china fixture.

a. Type: Ultra High Efficiency, Low Consumption.
b. Color: White.
c. Outlet Size: NPS 2 (DN 50).
d. Fixture Support: Urinal: J.R. Smith Model 0637M.
e. Height: Adult Standard (Refer to architectural drawings)
f. Flushometer: FV-2

2.9 LAVATORIES

A. Lavatories, P-3A (ADA):

1. Manufacturers: Basis of Design Product: Subject to Compliance with requirements, provide American Standard Lucerne Wall Hung Lavatory, or a comparable product of one of the following:

a. Kohler Company.
b. Sloan.

2. Description: Wall hung vitreous-china fixture.

a. Type: Wall hung.
b. Oval Lavatory Size: 20 by 18 inches.
c. Faucet Hole Punching: Three hole, 8" centers to match lav.
d. Faucet Hole Location: Top.
e. Color: White.
f. Faucet: LF-1.
g. Supplies: NPS 3/8 (DN 10) chrome-plated copper with loose key stops. Chicago Faucet Model 1006-ABCP with supply risers.
h. Drain: Grid, Chicago Faucet Fitting No. 327, 17 ga. tailpiece.
   1) Location: Near back of bowl.
i. Drain Piping: NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40) chrome-plated, cast-brass P-trap; NPS 1-1/2 (DN 40), 0.032-inch- (0.8-mm-) thick tubular brass waste to wall; and wall escutcheon.
j. Protective Shielding Guards: Required
k. Height: Adult ADA (Refer to architectural drawings)

2.10 MOP SINK

A. Mop Sink, P-4:

1. Manufacturers: Basis of Design Product: Subject to Compliance with requirements, provide Crane Plumbing, LLC/Fiat Products, Fiat Model TSB-3000, or a comparable product of one of the following:

   a. Acorn Engineering Company.
   b. Stern-Williams Co., Inc.
   c. Florestone Products Co., Inc.

2. Description: Flush-to-wall, floor-mounting, precast terrazzo fixture with rim guard.

   a. Shape: Rectangular.
   b. Size: 24 by 24 inches (915mm by 610 mm).
   c. Height: 12 inches (305 mm) with 6" dropped front.
   d. Tiling Flange: On all sides.
   e. Rim Guard: Stainless steel cap on all top surfaces.
   f. Color: Black and white marble chips.
   g. Faucet: SF-1.
   h. Drain: Grid with NPS 3 (DN 80) outlet.
   i. Wall Guards: Heavy gauge stainless steel on all walls.
   j. Mop Hangers: Provide four (4) hangers.

2.11 SINKS

A. Hand Sinks, P-5 (Accessible)

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay Model ELVW02219, or a comparable product by one of the following:

   a. Just Manufacturing.
   b. Advance Tabco.

2. Description: One-compartment, wall hung lavatory, stainless-steel commercial sink.

   a. Overall Dimensions: 22" x 19".
   b. Metal Thickness: 18 gauge, Type 304 (18-8) stainless steel.
   c. Compartment:

1) Dimensions: 16” x 11-1/2” x 5-1/2” deep.
2) Drain: Grid with NPS 1-1/2 (DN 40) tailpiece.
   a) Location: Near back of compartment.
3) Overflow Drain:
   a) Location: Back of compartment.

d. Faucet(s): SF-2.
   1) Number Required: One.
   2) Mounting: Deck.

e. Supplies: NPS 1/2 (DN 15) chrome-plated copper with loose-key, angle service stops. Chicago Model 1006-ABCP with supply risers.

f. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, cast-brass P trap with clean-out; 0.045-inch (1.1-mm) thick tubular brass waste to wall; and wall escutcheons.

B. Triple Compartment Sink, P-5A

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay model 3C12X16-2-12X, or a comparable product by one of the following:

   a. Just Manufacturing.
   b. Advance Tabco.

2. Description: Three-compartment, stainless-steel commercial sink with left and right drawboards and stainless steel legs.

   a. Overall Dimensions: 64” x 22” x 44”.
   b. Metal Thickness: 16-gauge, Type 300 stainless steel.
   c. Compartment (typical of 3):
      1) Dimensions: 12” x 16” x 10” deep.
      2) Drain: Grid with NPS 1-1/2 (DN 40) tailpiece.
         a) Location: Near back of compartment.

   d. Faucet(s): SF-3.
      1) Number Required: One.
      2) Mounting: Wall.

   e. Supplies: NPS 1/2 (DN 15) chrome-plated copper with loose-key, angle service stops. Chicago Model 1006-ABCP with supply risers.

   f. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, cast-brass P trap with clean-out; 0.045-inch (1.1-mm) thick tubular brass waste to wall; and wall escutcheons.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install counter-mounting fixtures in and attached to casework.

G. Install fixtures level and plumb according to roughing-in drawings.

H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

K. Install flushometer valves for accessible water closets with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

L. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

M. Install toilet seats on water closets.

N. Install trap-seal liquid in dry urinals.

O. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

P. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

Q. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

R. Install shower flow-control fittings with specified maximum flow rates in shower arms.

S. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

T. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

U. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Escutcheons for Plumbing Piping."

V. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

W. Install domestic cold water supply piping to each waterless urinal and cap behind wall.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposers and controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

E. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 40 00

SECTION 224700 - WATER COOLERS

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 water coolers and related components:

1. Pressure water coolers.
2. Fixture supports.

1.3 DEFINITIONS

A. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.

B. Cast Polymer: Dense, cast-filled-polymer plastic.

C. Fitting: Device that controls flow of water into or out of fixture.

D. Fixture: Water cooler unless one is specifically indicated.

E. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

F. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.

1.4 SUBMITTALS

A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for fixtures for people with disabilities.

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.

E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

A. Water Coolers, P-6 (Accessible with bottle filler):

1. Manufacturers: Basis of Design Product: Subject to compliance with requirements, provide Halsey Taylor, HTHBHVRBL-NF or a comparable product by one of the following:

   a. Haws Corporation.
   b. Oasis Corporation.

2. Description: Accessible, Outdoor, Bi-level, with bubbler and bottle filler wall-mounting water cooler.

   a. Cabinet: Bi-level with two attached cabinets made from all stainless steel.
   b. Bubbler: One located on each cabinet deck.
   c. Control: Front bubbler button with electronic bottle filler sensor.
   d. Supply: NPS 3/8 (DN 10) with ball, gate, or globe valve.
   e. Drain(s): Grid with NPS 1-1/4 (DN 32) minimum horizontal waste and trap complying with ASME A112.18.1.
   f. Cooling System: Non-refrigerated
   g. Support: Type I, water cooler carrier for each. J. R. Smith Model 0800. Refer to "Fixture Supports" Article.
   h. Filter: Without filter

3. Standards: ADA, ICC A 117.1, ASME A 112.19.3, NSF/ANSI 61 and 372, UL 399.

2.2 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Co.
2. MIFAB Manufacturing, Inc.
3. Smith, Jay R. Mfg. Co.
4. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
5. Wade.
6. Zurn Plumbing Products Group.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

1. Type I: Hanger type carrier with two vertical uprights.
2. Supports for accessible fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.

B. Examine walls and floors for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

B. Use mounting frames for recessed water coolers, unless otherwise indicated.

C. Set freestanding and pedestal drinking fountains on floor.

D. Set remote water coolers on floor, unless otherwise indicated.

E. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

E. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Escutcheons for Plumbing Piping."

F. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

G. Install mounting frames affixed to building construction and attach recessed, wall-mounted water coolers to mounting frames.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.

1. Remove and replace malfunctioning units and retest as specified above.
2. Report test results in writing.

3.6 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust water cooler temperature settings.

3.7 CLEANING

A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

3.8 WARRANTY

A. Provide three (3) year warranty for water coolers and a five (5) year parts, labor and refrigerant warranty for the refrigeration system.

B. Warranty shall start at substantial completion.

END OF SECTION 22 47 00

SECTION 230500 - COMMON WORK RESULTS 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.

1.2 SUMMARY

A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Concrete bases.
11. Supports and anchorages.

B. Provide all labor, materials, equipment, and services necessary for and incidental to the complete installation and operation of all mechanical work.

C. Unless otherwise specified, all submissions shall be made to, and acceptances and approvals made by the Architect and the Engineer.

D. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered. Arrange piping, ductwork, equipment, and other work generally as shown on the contract drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawings for approval in accordance with "Submittals" specified below. The right is reserved to make reasonable changes in location of equipment, piping, and ductwork, up to the time of rough-in or fabrication.

E. Conform to the requirements of all rules, regulations and codes of local, state and federal authorities having jurisdiction.

F. Be responsible for all construction means, methods, techniques, procedures, and phasing sequences used in the work. Furnish all tools, equipment and materials necessary to properly perform the work in first class, substantial, and workmanlike manner, in accordance with the full intent and meaning of the contract documents.

G. Indicate as separate line items in the Schedule of Values the following:
1. Coordination Drawings.
2. O & M Manuals.
3. Record Drawings/As-Builts.

H. Coordinate the work under Division 23 with work of all other construction trades.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:
1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in 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.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified at no cost to the owner. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

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. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 23.

D. Refer to installation and coordination drawings for additional information.

1.8 PERMITS AND FEES:

A. Obtain all permits and pay taxes, fees and other costs in connection with the work. File necessary plans, prepare documents, give proper notices and obtain necessary approvals. Deliver inspection and approval certificates to Owner prior to final acceptance of the work.

B. Permits and fees shall comply with the General Requirements of the specifications.

1.9 EXAMINATION OF SITE:

A. Examine the site, determine all conditions and circumstances under which the work must be performed, and make all necessary allowances for same. No additional cost to the Owner will be permitted for Contractor's failure to do so.

1.10 CONTRACTOR QUALIFICATION:

A. Any Contractor or subcontractor performing work under Division 23 shall be fully qualified and acceptable to the Architect. Submit the following evidence if requested.
   1. A list of not less than five comparable projects that the Contractor completed.
   2. Letter of reference form not less than three registered professional engineers, general contractors or building owners.
   3. Local and/or State License, where required.
   4. Membership in trade or professional organizations where required.

B. A Contactor is any individual, partnership, or corporation, performing work by Contract or subcontract on this project.

C. Acceptance of a Contractor or Subcontractor will not relieve the Contractor or subcontractor of any contractual requirements or his responsibility to supervise and coordinate the work, of various trades.

1.11 MATERIALS AND EQUIPMENT:

A. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the specified type and quality. This Contractor shall be responsible for connecting all utilities as shown on the Drawings to equipment identified as “Under Another Division”.

B. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish named item, or its equal of manufacturer indicated in this specification. Alternate Manufacturers (other than first named or indicated as the basis of design) shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of alternate manufacturers for review.

C. The suitability of named item only has been verified. Where more than one Manufacturer is named, only the first named Manufacturer has been verified as suitable. Manufacturers and items other than first named shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement and application. The contractor is responsible for all cost associated with alternate manufacturers if different than the basis of design including power connection requirements, structural cost, etc. The contractor is responsible for the burden of proof that submitted alternate manufactures meet the specification and performance requirements of the basis of design product.

D. Substitution (manufacturer or items not listed) will not be permitted for specified items of material or equipment.

E. The Contractor shall only submit those manufacturers indicated in the specification or included by Addendum. Proposed manufacturers not specified will not be considered unless the specific item indicates "or as approved equal" or “but are not limited to”. Submit all data necessary to determine suitability of alternative manufacturers’ items for approval. Failure to do so will result in a “Revise and Resubmit” response.

F. Refer to the General Conditions of this specification for additional information, including substitution request. Substitutions are for materials or manufacturers not listed in this specification. For each substitution proposed by the Contractor, the Contractor clearly identifies all differences (i.e., paragraph-by-paragraph, performance differences, physical differences, etc.) from the specified item, changes in Contract cost, benefits to the Owner and a brief description why the substitution is being proposed.

G. Where only one manufacturer is listed, provide that manufacturer-sole source.

1.12 FIRE SAFE MATERIALS

A. Unless otherwise indicated, materials and equipment shall conform to UL, NFPA or ASTM Standards for fire safety with smoke and fire hazard rating not exceeding flame spread of 25 and smoke developed of 50.

1.13 REFERENCED STANDARDS, CODES AND SPECIFICATIONS:

A. Specifications, Codes and Standards listed below are included as part of this specification, latest edition.

AABC	-	Associated Air Balance Council
ABMA	-	American Boiler Manufacturers Association
ACCA	-	Air Conditioning Contractors of America
ACGIH	-	American Conference of Governmental Industrial Hygienist
AIHA	-	American Industrial Hygiene Association
ASA	-	Acoustical Society of America
ADC	-	Air Diffusion Council
AGA	-	American Gas Association
AMCA	-	Air Movement and Control Association
ANSI	-	American National Standards Institute
ARI	-	Air Conditioning and Refrigeration Institute
ASHRAE	-	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AWWA	-	American Water Works Association
CABO	-	Council of American Building Officials
CAGI	-	Compressed Air and Gas Institute
CS	-	Commercial Standard
CSA	-	Canadian Standards Association
CISPI	-	Cast Iron Soil Pipe Institute
IBC	-	International Building Code, Latest Edition.
IBR	-	Institute of Boiler and Radiator Manufacturers
IEEE	-	Institute of Electrical and Electronics Engineers
IMC	-	International Mechanical Code, Latest Edition
MSSP	-	Manufacturers Standards Society of the Valve and Fittings Industry
NEC	-	National Electrical Code
NEMA	-	National Electrical Manufacturers Association
NFPA	-	National Fire Protection Association
NSPC	-	National Standard Plumbing Code, Latest Edition
SMACNA	-	Sheet Metal and Air Conditioning Contractors National Association
TEMA	-	Tubular Exchanger Manufacturers Association
UL	-	Underwriters' Laboratories

B. All mechanical equipment and materials shall comply with the codes and standards listed in the latest ASHRAE Handbook

1.14 SUBMITTALS REVIEW AND ACCEPTANCE:

A. Equipment, materials, installation, workmanship and arrangement of work are subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Engineer to be in the best interest of the Owner.

B. Within 30 calendar days after award of contract, submit Material and Equipment List for approval. List all materials and equipment, indicating manufacturer, type, class, model, curves, and other general identifying information.

C. After acceptance of Material and Equipment List, submit complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves,

operating characteristics, catalog cuts, dimensional drawings, sound data, performance certifications, wiring diagrams, specific electrical/wiring requirements and connections including control and interlock wiring, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project or submittal shall be rejected.

D. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and all electrical requirements for equipment submitted. Submit the Electrical Connection information specified in Division 26 for each piece of equipment requiring electrical connections. As a minimum, the Electrical Connection Information shall include horsepower or kVA, voltage and phase, power factor, capacitor, motor starter, disconnect and controls. Indicate which Division is providing the devices. Each piece of equipment and its associated components (fuses, relays, etc.) shall be clearly identified. Failure to include this schedule in the submittal will result in the submittal being returned to the Contractor for resubmission due to incompleteness of the submittal. If the Contractor submits equipment other than that used for the basis of design, and if the electrical connection requirements are different, the Contractor shall be responsible for any associated increase in cost (e.g., wiring, conduits, starters, disconnects, etc.). Maintain and submit a summary of all electrical connection schedules of approved equipment. All mechanical equipment must be approved before electrical distribution equipment shall be approved for fabrication (i.e., MC, switchboard, emergency generator, distribution panels, etc.) Contractor shall be responsible for correctness of all submittals.

E. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.

F. Identify submittals, indicating intended application, location and service of submitted items. Refer to specification sections or paragraphs where applicable. Clearly indicate exact type, model number, manufacturer, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For all items clearly list on the first page of the Submittal all differences between the specified product and the submitted product. Additionally, for items other than first-named or indicated as the Basis of Design, clearly list on the first page of the submittal all differences between the specified item and the proposed item. This includes a paragraph-by-paragraph comparison from the Specification, performance differences from that scheduled and/or indicated on the Drawings, including power connection requirements, sound, etc., and physical differences (size, weight, etc.) based on published data (i.e., including Web sites.) The Contractor shall be responsible for all cases associated with utilizing materials and equipment other than first named (including cost for all other trades such as electrical connection requirements) including corrective action (or replacement with the specified item) while maintaining the specification requirements.

G. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable.

H. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted.

1.15 SHOP DRAWINGS:

A. Prepare and submit shop drawings within ten calendar days after award of contract for all specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown on contract drawings.

B. Submit data and shop drawings as listed below, in addition to provisions of paragraph 1 above. Identify all shop drawings by the name of the item and system and the applicable specification paragraph number.

Items and Systems Included But Not Limited To:

Access Doors.
Air Distribution Systems.
Air Handling Units (all types).
Automatic Temperature Control & Energy Management System & Equipment.
Duct-Mounted Heating Coils.
Energy Recovery Unit.
Fans.
Fan Coil/Blower Coil Units (All Types).
Fire Stopping - Methods and Materials.
Flowmeters and Primary Elements. (Flow Fittings)
Grilles, Registers, Diffusers, and Fire Dampers.
Gravity Roof Vents.
Identification System.
Pipe Materials and Fittings.
Pipe Sleeves Including Sealants.
Pumps, Circulators, Suction Diffusers, Multi-Purpose Valves.
Roof Curb Assemblies.
Sleeves.
Thermal Insulation Materials.
Vibration Isolation.

C. Contractor, additionally, shall submit for approval any other shop drawings as required by the Architect or Owner. No item listed above shall be delivered to the site, or installed, until approved. After the proposed materials have been approved, no substitution will be permitted except where approved by the Architect/Owner.

1.16 SUPERVISION AND COORDINATION

A. Provide complete supervision, direction, scheduling, and coordination of work under the Contract, including that of subcontractors.

B. Coordinate rough-in of work and installation of sleeves, anchors, and supports for piping, ductwork, and other work performed under Division 23.

C. Coordinate electrical work required under Division 23 with that under Division 26. Coordinate work under Division 23 with work under other Divisions.

D. Coordinate the work under Division 23 with the work of all other construction trades.

E. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

F. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

G. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 23.

1.17 CUTTING AND PATCHING

A. Accomplish all cutting and patching necessary for the installation of work under Division 23. Damage resulting from this work to other work already in place, shall be repaired at Contractor's expense. Where cutting is required, perform work in neat and workmanlike manner. Restore disturbed work to match and blend with existing, using materials compatible with the original. Use mechanics skilled in the particular trades required.

B. Do not cut structural members without approval.

1.18 PENETRATION OF WATERPROOF CONSTRUCTION:

A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls, and interior waterproof construction. Where such penetrations are necessary, furnish and install all necessary curbs, sleeves, flashings, fittings and caulking to make penetrations absolutely watertight.

B. Where vents or other pipes penetrate roofs, flash pipe with All American Metal, Inc., or approved equal, roof flashing assemblies, with 4-pound lead, 6-inch skirt and caulked counterflashing sleeve with lead cap and shall be installed by the Roofing Contractor.

C. Furnish and install roof drains, vent assemblies, and duct sleeves specifically designed for application to the particular roof construction, and install in accordance with the manufacturer's instructions, The National Roofing Contractors Association, SMACNA and as required by other divisions of this specification. The Contractor shall be responsible for sleeve sizes and locations.

D. Roof curbs for mechanical systems and equipment shall be furnished by the Mechanical Contractor and installed by the Roofing Contractor.

E. Pitch pockets are prohibited. Provide curb assemblies and pipe portals with watertight boots (pate type PCC or equal) as detailed on the drawings.

F. Coordinate all roof penetration, flashing and installation of roof mounted equipment with the Roofing Contractor.

1.19 VIBRATION ISOLATION

A. Furnish and install vibration isolators, flexible connections, supports, anchors, and/or foundations required to prevent transmission of vibration from equipment, piping, or ductwork to building structure. Penetrations of ductwork, piping, and conduits through walls and floor/ceiling/roof assemblies shall be oversized by ½”-1”. There shall be no contact between the penetrating element and the partition and the resultant gap shall be filled with closed cell foam backer rod and acoustical sealant for an air tight seal. See Section 230548, VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT.

1.20 ACCESSIBILITY

A. All equipment shall be installed in such a way that all components requiring access (such as panels, disconnect switches, circuit breakers, starters, and accessories) are so located and installed that they may be serviced, reset, replaced, recalibrated, etc., by service technicians in accordance with the Manufacturer’s recommendations. If any equipment or components are

located in such a position that this Contractor cannot comply with the above, the Contractor shall notify the engineer in writing before equipment is installed.

1.21 CONCRETE AND MASONRY WORK:

A. Furnish and install concrete and masonry work for equipment foundations, supports, pads, and other items required under Division 23. Perform work in accordance with requirements of other applicable Divisions of these specifications. Coordinate size and location of all sleeves, concrete inserts, etc., with other Divisions, equipment connections, and approved casework Shop Drawings.

B. Concrete shall test not less than 5,000 psi compressive strength after 28 days.

C. Grout shall be non-shrink, high strength mortar, free of iron of chlorides and suitable for use in contact with all metals, without caps or other protective finishes. Apply in accordance with manufacturer's instructions and standard grouting practices.

D. Provide 3”-4” of light weight (perilite-30-35 PCF) concrete within rooftop air handling unit curbs.

1.22 DRIVE GUARDS

A. Provide safety guards on all exposed belt drives, motor couplings, and other rotating machinery. Provide fully enclosed guards where machinery is exposed from more than one direction.

B. Fabricate guards of heavy gauge steel, rigidly brace, removable, and finish to match equipment served. Provide openings for tachometers. Guards shall meet O.S.H.A. and Authorities Having Jurisdiction requirements.

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. 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. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless 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.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, galvanized steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Available Manufacturers:

a. Eslon Thermoplastics.

B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Thompson Plastics, Inc.

C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Manufacturers:

a. NIBCO INC.
b. NIBCO, Inc.; Chemtrol Div.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:
a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.

E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

1. Manufacturers:
a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.
   e. Linkseal.

2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless Steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, galvanized, plain ends.

B. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with set screws.

C. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Cast-Brass Type: With set screw.
1. Finish: Polished chrome-plated.

C. One-Piece, Floor-Plate Type: Cast-iron floor plate.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

M. Sleeves are required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are two pipe sizes larger than pipe or pipe insulation.
      a. Galvanized Steel Pipe Sleeves: For pipes penetrating floors, walls and roofs except where noted through membrane waterproofing.
      b. Galvanized steel sheet sleeves: For pipes penetrating gypsum-board partitions.
      c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing. Seal space outside of sleeve fittings with grout.
      d. Provide galvanized steel sheet sleeves for interior stud partitions.
      e. Provide galvanized steel wall sleeves with sleeve seal system for walls below grade and concrete slabs on grade. Select sleeve size to allow one-inch annular clear space between piping and sleeve for installing sleeve seal system. Select type, size and number of sealing elements required for piping material and size for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve 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 water-tight seal.

   4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size two pipe sizes larger than pipe and sleeve for installing mechanical sleeve seals.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. 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 unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   4. PVC Nonpressure Piping: Join according to ASTM D 2855.
   5. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 (DN 50) and smaller at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric nipples and flanges to connect piping materials of dissimilar metals.
   4. Wet Piping Systems: Install dielectric nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting," unless otherwise indicated.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work. For interior components, paint bare, untreated ferrous surfaces with rust-inhibiting paint. All exterior components including supports, hangers, vibration isolators, etc., shall be galvanized or stainless steel. All exterior fastening components such as rods, nuts, bolts, washers, etc., shall be stainless steel.

D. Clean surfaces prior to application of insulation, adhesives, coatings, paint, or other finishes.

E. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pretreatment.

F. Protect all finishes and restore any finishes damaged as a result of work under Division 23 to their original condition.

G. The preceding requirements apply to all work, whether exposed or concealed.

H. Remove all construction marking and writing from exposed equipment, piping and building surfaces. Do not paint manufacturer's labels or tags.

I. All exposed ductwork, piping, equipment, etc. shall be painted. All finishes shall have a paint grip finish, including galvanized ductwork which shall be Gavanneal type. Colors shall be selected by the Architect and conform to ANSI Standards.

J. Submit color of factory-finished equipment for approval prior to ordering. Color of finishes shall be as selected by Architect. All exposed cabinets for equipment (e.g., fin tube radiation, fan coil units, cabinet unit heaters, terminal heating devices, etc.) in finished areas shall be provided with custom colors as selected by the Architect.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 5000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section “Miscellaneous Cast-in-Place Concrete."
   8. Housekeeping pads for air handling units and central plant generation equipment (boilers, heat pumps, etc.) shall be a minimum of 6-inches thick. All other equipment pads shall be a minimum of 4-inches thick.
   9. Provide wire-mesh or re-bar reinforcement; chamfer exposed edges and corners; and finish exposed surfaces smooth.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.9 SUPPORTS, HANGERS, AND FOUNDATIONS

A. Provide supports, hangers, braces, attachments and foundations required for the work. Support and set the work in a thoroughly substantial and workmanlike manner without placing strains on materials, equipment, or building structure, submit shop drawings for approval. Coordinate all work with the requirements of the structural division.

B. Supports hangers, braces, and attachments shall be standard manufactured items or fabricated structural steel shapes. All interior hangers shall be galvanized or steel with rust inhibiting paint. For uninsulated copper piping/tubing provide copper hanger with wool or felt insert to prevent contact of dissimilar metals. All exterior hangers shall be constructed of galvanized steel or stainless steel utilizing stainless steel rods, nuts, washers, bolts, etc.

C. No support or hanger shall attach to the metal roof deck.

D. Hangers shall attach at the panel point of the top chord of joist.

3.10 PROVISIONS FOR ACCESS:

A. The Contractor shall provide access panels and doors for all concealed equipment, valves, strainers, manual, gravity and automatic dampers, filters, controls, control devices, cleanouts, fire dampers, smoke dampers, combination fire and smoke dampers, damper operators, traps, and other devices requiring maintenance, service, adjustment, balancing or manual operation.

B. Where access doors are necessary, furnish and install manufactured steel door assemblies consisting of hinged door, cylinder with key locks (keyed alike), and frame designed for the particular wall or ceiling construction. Style M access door shall have stainless steel finish. All others shall have paintable finish. Properly locate each door. Review all locations with the Engineer and Architect in the field before installation. Door size shall be a minimum of 24" x 24". Provide UL approved and "B" labeled 12-Hour Access doors where installed in fire-rated walls or ceilings. Doors shall be Milcor Metal Access Doors as manufactured by Inland-Ryerson, Air Balance, Inc., Cesco, Karp Associates, Kees, or approved equal.

1. Acoustical: Style AT
2. Hard Finish Plaster: Style K
3. Dry Wall: Style DW
4. Masonry Style M

C. Where access is by means of lift-out ceiling tiles or panels, mark each ceiling grid using small color-coded or numbered tabs. Provide a chart or index for identification. Charts shall be similar to valve charts specified hereinafter. Screw markers on ceiling grid.

D. Access panels, doors, etc., described herein shall be furnished under the section of specifications providing the particular service to be turned over to the pertinent trade for installation. Coordinate installation with installing Contractor.

E. Per the school districts standard provide white micarta nameplates with black lettering, the width of the ceiling grid, fastened by adhesive indicating the fan coil unit/blower coil unit, terminal control unit (VAV) located above the ceiling (e.g.,VAV-X).

3.11 PROTECTION OF WORK:

A. Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment.

B. Cover temporary openings in piping, ductwork, and equipment to prevent the entrance of water, dirt, debris, or other foreign matter.

C. Cover or otherwise protect all finishes.

D. Replace damaged materials, devices, finishes and equipment.

3.12 OPERATION OF EQUIPMENT:

A. Clean all systems and equipment prior to initial operation for testing, balancing, or other purposes. Lubricate, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is authorized for operation during construction.

B. Provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment.

C. Do not use mechanical systems for temporary services during construction unless authorized in writing by the Owner or Architect. Where such authorization is granted, temporary use of equipment shall in no way limit or otherwise affect warranties or guaranty period of the work.

D. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items such as filters.

E. If the mechanical systems are used at any time without written authorization from the Owner, other than for initial factory start-up and/or testing, balancing, and commissioning, all equipment and duct systems shall be thoroughly cleaned by this Contractor (i.e., coils, fans, variable speed drives, heat wheels, terminal units, split systems, supply, return and exhaust ducts, etc.) to restore the system and equipment to like-new condition. The Contractor is still responsible for all external cleaning to restore systems and equipment to like-new conditions. At no time will the HVAC be allowed to run when sanding, grinding, finishing, etc., type activities create dust.

3.13 IDENTIFICATIONS, FLOW DIAGRAMS, ELECTRICAL DIAGRAMS AND OPERATING INSTRUCTIONS:

A. Contractor shall submit for approval schematic piping diagrams of each piping system installed in the building. Diagrams shall indicate valve location, service, type (i.e., butterfly, globe, ball, etc.) make, model number and the identification number of each valve in the particular system. Following approval by all authorities, the diagrams shall be framed, mounted under glass and hung in each Mechanical Room. Contractor shall deliver the electronic file from which the diagrams were reproduced to the Owner.

B. All valves shall be plainly tagged. Where valves are located above ceilings, mark the ceiling grid using a small color-coded or numbered tab. Screw marker to grid.

C. All items of equipment, including motor starters, ATC panels, terminal control units, etc., shall be furnished with white letters and numbers on black plastic identification plates or aluminum letters and numbers on black engraved aluminum identification plates. Lettering shall be a minimum of 1/4" high. Identification plates shall be securely affixed to each piece of equipment, starters, panels, etc. by screws. Pressure sensitive tape backing is prohibited. Utilize the school district coding system to match the school districts preventative maintenance system requirements. Coordinate with Owen J. Roberts School District.

D. Provide three (3) copies of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the "Record and Information Booklet" as hereinafter specified. Project shall not be considered “Substantially Completed” until provided.

E. All lines (piping and ductwork) installed under this contract shall be stenciled with "direction of flow" arrows and with stenciled letters naming each pipe and ductwork and service. Refer to Division 23 sections on piping. At the Contractors option, snap/strap around pre-coiled vinyl markers are acceptable.

F. Provide at least 40 hours of straight time instruction to the operating personnel. This instruction period shall consist of not less than five (5) 8-hour days. Time of instruction shall be designated by the Owner. As a minimum, three (3) additional eight (8) hour instruction times shall occur during 1) the first cooling season, 2) the first heating season, and 3) the first intermediate cooling/heating season. Additional instruction time for the Automatic Temperature Control (ATC) and Energy Management System (EMS) is specified in Section 230900 Automatic Temperature Controls. Provide two (2) DVD-recorded copies of all instructional periods/demonstrations including Automatic Temperature Control and Energy Management System.

3.14 WALL AND FLOOR PENETRATIONS

A. Provide sleeves for pipes and ducts passing through roofs, floors, ceiling, walls, partitions, air handling unit casings, structural members, and other building parts. Sleeves shall extend 2” above finished floor.

B. Provide escutcheons for sleeved pipes in finished areas.

C. Piping sleeves:
   1. Galvanized steel pipe, standard weight where pipes are exposed and, roofs and concrete and masonry walls. On exterior walls provide anchor flange welded to perimeter.
   2. Twenty-two (22) gauge galvanized steel elsewhere.
   3. Hydrostatic sleeves with anchor flange for all below-grade exterior wall or floor penetrations and all PVC pipe penetrations.

D. Ductwork sleeves: 20-gauge galvanized steel at masonry walls, rated walls, at wall penetrations exposed to view, floors and roof.

E. Penetrations shall be sealed and caulked airtight for sound and air transfer control. Voids where ducts and pipes penetrate floors or other fire-rated assemblies shall be appropriately additionally fire-sealed the full depth with an approved fire sealant (3M or Dow Corning Fire Sealant Foam and Caulk). For piping, provide floor plate.

F. Where piping extends through exterior walls, provide link-seal water-proof sleeves or equivalent.

3.15 RECORD DRAWINGS

A. Upon completion of the mechanical installations, the Contractor shall deliver to the Architect one complete set of prints of the mechanical contract drawings which shall be legibly marked in red pencil to show all changes and departures of the installation as compared with the original design. They shall be suitable for use in preparation of Record Drawings. Additionally, provide one (1) electronic format (color PDF/scanned image) of all record drawings on a DVD.

3.16 GUARANTEE:

A. Contractor's attention is directed to guarantee obligations contained in the GENERAL CONDITIONS.

B. The above shall not in any way void or abrogate equipment manufacturer's guarantee or warranty. Certificates of guarantee shall be included in the operations and maintenance manuals. The project shall not be considered "substantially completed" until certifications are included in the Record and Information Booklets.

C. Contractor shall provide two (2) year full factory warranty on parts and labor for all equipment from the time of final acceptance of the mechanical systems by the Owner. Warranty shall include 24-hour service. Contractor shall provide five (5) year parts and labor warranty for all refrigeration systems (i.e., split systems/condensing units), including loss of refrigerant. The variable refrigerant flow (VRF) shall be provided with a ten (10) year warranty. Additional special extended warranties are included in equipment and material specification sections. This service shall be rendered upon request when notified of any equipment malfunctions.

D. The guarantee shall not start until substantial completion has been accepted by the Owner.

3.17 LUBRICATION:

A. All bearings, motors, and all equipment requiring lubrication shall be provided with accessible fittings for same. Before turning over the equipment to the Owner, the Contractor shall fully lubricate each item of equipment, shall provide one year's supply of lubricant for each, and shall provide Owner with complete written lubricating instructions, together with diagram locating the points requiring lubrication. Include this information in the Record and Information Booklet. Project shall not be considered "Substantially Completed" until instructions are included in the Record and Information Booklet.

B. In general, all motors and equipment shall be provided with grease-lubricated roller or ball bearings with Alemite or equal accessible or extended grease fittings and drain plugs.

C. Provide remote grease fittings with copper lube lines for air handling units and for bearings/motors where grease fittings are situated in locations inconvenient/inaccessible for lubrication.

D. Provide pressure relief fittings at all grease lubrication locations designed to automatically vent within the range of 1/4 to 1 psi, automatically reset below this range, or another pressure relief range if the preceding differs from the manufacturer's recommended pressure range.

3.18 RECORD AND INFORMATION BOOKLET:

A. The Contractor shall have prepared three (3) copies of the Record and Information Booklet and deliver these approved copies of the booklet to the Owner a minimum of three (3) weeks before Demonstrations. The booklet shall be as specified herein. The booklet must be approved and will not be accepted as final until so stamped. The project shall not be considered "Substantially Completed" until approved.

B. The booklet shall be bound in a three-ring loose-leaf binder similar to "National" No. 3881 with the following title lettered on the front: "Record and Information Booklet (insert name of the project)". No sheets larger than 8-1/2" x 11" shall be used, except sheets that may be neatly folded to 8-1/2" x 11" and used as a pull-out.

C. Provide the following data in the booklet:
   1. Catalog data on each piece of mechanical equipment furnished.
   2. Maintenance operation and lubrication instructions on each piece of equipment furnished.
   3. Complete catalog data on each piece of heating and air conditioning equipment furnished including approved shop drawing.
   4. Manufacturers' and Contractors' guarantees.
   5. Chart form indicating time and type of routine maintenance of chillers, boilers, air handling units, heat recovery devices, condensing units, VAV boxes, VRF system, energy recovery devices, ATC System, pumps, fans, chemical treatment, unit heaters, etc. The chart shall also indicate tag number, model number of equipment, location and service. For replacement items such as filters and belts, indicate type, size and quantity of the replaceable items.
   6. Provide sales and service representatives' names and phone numbers of all equipment and subcontractors.
   7. Catalog data of all equipment, valves, etc., which shall include wiring diagrams, parts list and assembly drawing.
   8. Provide valve chart including valve tag number, valve type, valve model number, valve manufacturer, style, service and location, etc. as specified hereinafter.
   9. Copy of the approved balancing report.
   10. Provide operating curves indicating design and balanced conditions for fans and pumps.
   11. ATC systems, including as-built ATC drawings of systems, sequences of operation including internal devices and wiring within panels.
   12. Provide an electronic data base of all equipment, including model number, location tag/identification label.
   13. Provide copies of all flushing reports.
   14. Provide copies of all start-up reports.

D. In addition to three (3) hard copies of the data described in Paragraph C, provide three (3) electronic copies in PDF format on external hard drives of the entire O&M Manual.

3.19 TESTS, GENERAL:

A. The entire heating and cooling system shall be tested hydrostatically for a duration of 4 hours before insulation covering is applied and proved tight under the following gauge pressures:
   1. Coil Drain Piping 100 psi

B. All testing shall be witnessed by the Owner or Engineer and Local Code Official. The Contractor shall provide a minimum of 48-hour notice before testing. The Contractor shall coordinate with and get approval from the Owner.

3.20 LINTELS:

A. Under this Section, provide lintels not provided elsewhere which are required for openings for the installation of mechanical and plumbing work. Lintels shall meet the requirements of the Architectural and Structural Sections and The Architectural Drawings and Specifications.

3.21 EQUIPMENT BY OTHERS:

A. This Contractor shall make all system connections required to equipment furnished and installed under other divisions. Connections shall be complete in all respects to render this equipment functional to its fullest intent.

B. It shall be the responsibility of the supplier of this equipment to furnish complete instructions for connections. Failure to do so will relieve this Contractor of any responsibility for improper equipment operation.

C. Typical equipment refers to, but is not limited to kiln hoods, kitchen equipment, etc.

3.22 FASTENERS:

A. All fasteners located in public space (toilet rooms, corridors) shall be provided with tamper-proof type fasteners.

3.23 WIRING DIAGRAMS

A. Obtain and submit wiring diagrams for all equipment provided under this Contract.

B. Wiring diagrams shall be provided with Shop Drawings, but not limited to, the following:
1. All equipment.
2. ATC System.

C. The Contractor shall submit any additional wiring diagrams as requested by the Engineer.

D. Provide wiring diagrams for all major mechanical equipment to the Electrical Contractor and the ATC Subcontractor for coordination.

3.24 INSTALLATION AND COORDINATION DRAWINGS

A. Prepare, submit, and use composite installation and coordination drawings to assure proper coordination and installation of work. Drawings shall include, but not be limited, to the following: Complete Ductwork, Plumbing, Sprinkler and HVAC Piping Drawings showing coordination with approved equipment, approved casework drawings, lights, conduits 2" and larger, electrical equipment and structural. The Mechanical Contractor is responsible for coordinating with all trades to insure systems will fit in the available space. If conflicts exist after fabrication and/or installation of systems prior to preparing a coordinated drawing of the area, the Contractor shall remove, re-fabricate, and re-install all such work at their own cost, except for the difference in cost, if any, from the originally designed system to the revised design. If no design changes were made, and clarifications were required, it shall be at no expense to the Owner.

B. Draw plans to a scale not less than 3/8-inch equals one foot. Include plans, sections, and elevations of proposed work, showing all equipment, piping and ductwork in areas involved. Fully dimension all work including hoods, casework and associated utilities, valve boxes, lighting fixtures, conduits, pullboxes, panelboards, and other electrical work, telecommunications equipment, walls, doors, ceilings, columns, beams, joists and other architectural and structural work.'

C. Identify all equipment and devices on wiring diagrams and schematics. Where field connections are shown to factory-wired terminals, include manufacturer's literature showing internal wiring.

D. All coordination drawings shall be prepared in AutoCAD or Revit format and submitted in color. Different colors shall be used to determine different building components. In addition to the composite coordination drawings, simultaneously submit individual sheet-metal, piping, and sprinkler coordination drawings.

E. Prepare separate coordinated reflected ceiling plans in 1/8", 1/4", or 3/8" scale showing grid systems, lighting fixtures, communication system components, TV brackets, sprinkler heads, air devices, and all other ceiling-mounted items.

F. The Mechanical Contractor shall schedule bi-weekly Coordination Drawing Reviews with the Owner, Mechanical Engineer, and all associated subcontractors, including but not limited to the following:
1. Mechanical Contractor
2. Wood Truss Contractor
3. Sheet Metal Contractor
4. Sprinkler Contractor
5. Electrical Contractor
6. Plumbing Contractor
7. Owner/Architect/Engineer
8. Note: A Foreman or Project Manager responsible for Decision-Making of each company shall attend all Coordination Meetings.

G. The purpose of these meetings is to coordinate proposed installations of systems and equipment, including clearances, routing, penetrations, as well as to review potential conflicts. The Mechanical Contractor shall base preliminary equipment sizes and connections on proposed products and the final coordination drawing for review shall reflect approved/reviewed products. Coordination Meetings shall be held at the Contractor's Field Office.

H. The Mechanical Contractor is responsible to coordinate all equipment and systems to be installed in the attic space with the General Contractor and the wood truss manufacturer/contractor prior to the wood truss system design.

3.25 BOILER AND PRESSURE VESSELS

A. All boilers and pressure vessels shall be ASME-rated and shall comply with the State of Pennsylvania requirements.

B. Provide all control devices and materials, and install in with ASME CSD-1 Controls and Safety Devices for Automatically Fired Boilers.

3.26 FACTORY START-UP

A. Provide factory authorized start-up service for all mechanical equipment (e.g., energy recovery ventilator drives, condensing units, fans, blower/fan coil units, etc.).

B. Provide one copy of all start-up reports to the Owner and include a copy in the Record and Information Booklet.

3.27 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment including, but not limited to, the following:
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 mounting heights are not detailed, noted, 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.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished space.
10. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of equipment components in accordance with manufacturers' recommendations. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install access panels or doors where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.28 CLEANING OF SYSTEMS:

A. Thoroughly clean systems after satisfactory completion of pressure tests and before permanently connecting fixtures, equipment, traps, strainers, and other accessory items. Shut-off valves serving equipment where by-pass valves have been provided shall be closed to the equipment and by-pass valves shall be open during flushing. Blow out and flush piping until interiors are free of foreign matter. Restore valves to their normal operating positions after flushing has been completed. Flushing, chemicals, sterilization, etc., shall comply with EPA Regulations and authorities having jurisdiction.

B. Flush piping in recirculating water systems to remove cutting oil, excess pipe joint compound and other foreign materials. Do not use system pumps until after cleaning and flushing has been accomplished to the satisfaction of the Engineer. Employ chemical cleaners, including a non-foaming detergent, not harmful to system components. After cleaning operation, final flushing and refilling, the residual alkalinity shall not exceed 300 parts per million. Submit a certificate of completion to Engineer stating name of service company that was used. Project shall not be considered "substantially completed" until certificate is incorporated in the "Record and Information Booklet".

C. Leave strainers and dirt pockets in clean condition.

D. Clean fans, ductwork, enclosures, registers, grilles, and diffusers at completion of work.

E. Install filters of equal efficiency to those specified in permanent air systems operated for temporary heating or cooling for testing and balancing. At no time shall the permanent equipment be used during construction except as required for testing and balancing and/or

commissioning of systems, which shall be approved by the Owner. Replace with clean filters as specified prior to acceptance and after cleaning of system.

F. Leave systems clean, and in complete running order.

3.29 LOUVERS:

A. All louvers to be provided in exterior walls shall be furnished and installed under another division unless otherwise indicated on the drawings or in the specifications. All brick vents shall be provided under this division. Louver shop drawings shall be submitted to the Engineer to verify sizes and free area requirements. The Contractor shall blank-off unused portions of louver with insulated double wall type blank-off panels.

3.30 FILTERS:

A. Provide one (1) set of clean filters for balancing. Two (2) complete set of additional filters shall be turned over to the Owner upon final acceptance of the building by the Owner. Provide correspondence documenting that additional filters have been turned over to the Owner.

B. All air handling unit pre-filters shall be 2" thick, 30% efficient (MERV 8), Camfil Farr 30/30, or as approved equal. All final filters shall be 12 thick, 65% efficient (MERV 11), Camfil Farr HP-P65 with Media Retainer Assembly, or as approved equal. Where final filters are indicated to be 4" thick, provide 65% efficient (MERV11) Camfil Farr Opti-Pac.

C. Provide MERV 11 filters for all intakes (return air grilles, outside air louvers, all AHU and terminal unit filters, etc.), if for any reason (start-up, testing and balancing, commissioning, etc.) the units are started prior to final building cleaning. Filters shall be 1", 2" or 4" thick; Camfil Farr AP-11, or as approved equal.

D. Provide one (1) differential pressure gauge across each filter bank. Differential pressure gauge shall be diaphragm activated, dial type, +/-2% accuracy of full scale, static pressure tips, aluminum tubing, vent valves, etc. Differential pressure gauge shall be Series 2000 magnahelic with air filter kit as manufactured by Dwyer or equal.

3.31 BELT GUARDS/CAGES/BELTS

A. Provide safety guards on all exposed belt drives, motor couplings, and other rotating machinery (pump coupling, plenum fans, propeller fans, etc.) Provide fully enclosed guards where machinery is exposed form more than one direction.

B. Fabricate guards of heavy gauge steel, rigidly braced, removable, and finished to match equipment served. Provide openings for tachometers. Guards shall meet OSHA requirements.

C. Provide one (1) spare set of belts for each piece of equipment. Belts shall be labeled with unit number and location. Belts shall be mounted as directed by the Owner.

3.32 ACCESS FOR INSPECTION, CLEANING AND MAINTENANCE

A. Individual finned-tube coils or multiple finned-tube coils in series without adequate intervening access space(s) of at least 18 inches (457 mm) shall be selected to result in no more than 0.75 inches wc (187 Pa) combined pressure drop when dry coil face velocity is 500 fpm (2.54 m/s).

Exception: When clear and complete instructions for access and cleaning of both upstream and downstream coil surfaces are provided.

B. Equipment Clearance: Ventilation equipment shall be installed with sufficient working space for inspection and routine maintenance (e.g., filter replacement and fan belt adjustment and replacement).

C. Ventilation Equipment Access: Access doors, panels, or other means shall be provided and sized to allow convenient and unobstructed access sufficient to inspect, maintain, and calibrate all ventilation system components for which routine inspection, maintenance, or calibration is necessary. Ventilation system components comprise, for example, air-handling units, fan-coil units, water-source heat pumps, other terminal units, controllers, and sensors.

D. Air Distribution System: Access doors, panels, or other means shall be provided in ventilation equipment, duct-work, and plenums, located and sized to allow convenient and unobstructed access for inspection, cleaning, and routine maintenance of the following:
1. Outdoor air intake areaways or plenums
2. Mixed air plenums
3. Upstream surface of each heating, cooling, and heat-recovery coil or coil assembly having a total of four rows or less
4. Both upstream and downstream surface of each heating, cooling, and heat-recovery coil having a total of more than four rows and air washers, evaporative coolers, heat wheels, and other heat exchangers
5. Air cleaners
6. Drain pans and drain seals
7. Fans

3.33 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

D. **END OF SECTION 23 05 00**

SECTION 230529 - HANGERS AND SUPPORTS 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.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Division 23 Section "Vibration Controls for HVAC Piping and Equipment" for vibration isolation devices.
4. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC 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.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. 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. Design Calculations: Calculate requirements for designing trapeze hangers.

D. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel or zinc-plated carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components. Provide felt or wool inserts.

2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel or copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 stainless steel or zinc-plated carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Allied Tube & Conduit.
    b. Cooper B-Line, Inc.
    c. Flex-Strut Inc.
    d. GS Metals Corp.
    e. Thomas & Betts Corporation.
    f. Unistrut Corporation; Tyco International, Ltd.
    g. Wesanco, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel 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 stainless steel or zinc-coated stainless steel.
7. Metallic Coating: Hot-dipped galvanized.
8. Paint Coating: Rust-inhibiting paint.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by Anvil International, Figure 45 Channel Assembly or comparable product by one of the following:
    a. Empire Industries, Inc.
    b. ERICO International Corporation.
    c. Haydon Corporation; H-Strut Division.
    d. PHD Manufacturing, Inc.
    e. PHS Industries, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous steel channel assembly with inturned lips.
5. Channel Nuts: Formed or stamped steel 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 stainless steel or zinc-coated carbon steel.
7. Coating: Rust-inhibiting paint or galvanized.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by Anvil International, Figure 45 Channel Assembly, or comparable product by one of the following:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Rilco Manufacturing Co., Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water repellant-treated, ASTM C 533, Type 1, with 100 psig minimum compressive strength or ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: 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.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components (galvanized or stainless steel supports and stainless steel fasteners, rods, nuts, washers, attachments, etc.) to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb. All supports shall be hot-dipped galvanized construction with stainless steel rods, fasteners, etc.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes. All supports shall be hot-dipped galvanized construction with stainless steel rods, fasteners, etc.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, 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 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. 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 framing 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 (100 mm) 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.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane. Condensate drain systems only.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. 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.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. 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 (DN 65) 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.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. 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.

N. 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 (DN 100) 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 (DN 100) 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 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.

5. Pipes NPS 8 (DN 200) 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 same thickness as piping insulation.

O. Pipe hangers and supports shall be attached to the panel point at the top chord of bar joist or at a location approved by the Structural Engineer. Do not support all parallel piping from the same bar joist (pipe sizes 3-inches and larger) unless approved by the Structural Engineer.

3.2 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.

3.3 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.

3.4 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 (40 mm).

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as 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 areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 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 finish.

D. Use nonmetallic coatings or inserts on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use painted or zinc-coated carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general interior service applications. Use galvanized or stainless steel pipe hangers and supports, trapeze pipe hangers, and framing systems and attachments for exterior service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: 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 (DN 15 to DN 750).

2. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
3. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
4. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
5. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
6. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
7. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
8. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
9. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
10. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

J. 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 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.

L. Building Attachments: 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. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb (340 kg).
    b. Medium (MSS Type 32): 1500 lb (680 kg).
    c. Heavy (MSS Type 33): 3000 lb (1360 kg).

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: 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.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
3. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
4. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
5. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
6. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners instead of building attachments where required in concrete construction.

R. Regardless of spacing, hangers shall be provided at all changes in direction, both vertical and horizontal, for all piping.

S. Where not practical to obtain ceiling anchorage, all piping near walls shall be supported by approved brackets securely anchored into the wall construction.

T. For piping located in and supported from the building structure, hanger spacing and rod sizes for steel and copper pipe shall not be less than the following for horizontal piping:

Nominal Pipe Size Inches	Maximum Span Feet		Minimum Rod Diameter inches of ASTM A36 Steel Threaded Rods
	Standard Steel Pipe	Copper Tube	
3/4 & 1	6	5	3/8
1 – 1/4	6	6	3/8
1-1/2	8	6	3/8
2	8	8	3/8
2-1/2	8	8	1/2
3	10	10	1/2
4	10	10	5/8
5	10	10	5/8
6	12	12	3/4
8	12	12	7/8
10	14	12	7/8
12	14	12	7/8

END OF SECTION 23 05 29

SECTION 23 05 48 - VIBRATION CONTROLS 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.

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Freestanding and restrained spring isolators.
5. Housed spring mounts.
6. Elastomeric hangers.
7. Spring hangers.
8. Spring hangers with vertical-limit stops.
9. Pipe riser resilient supports.
10. Resilient pipe guides.
11. Freestanding and restrained air-mounting system.
12. Restrained vibration isolation roof-curb rails.
13. Seismic snubbers.
14. Restraining braces and cables.
15. Steel and inertia, vibration isolation equipment bases.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:
1. Minimum 10 lb/sq. ft. (48.8 kg/sq. m) multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

C. Welding certificates.

D. Qualification Data: For engineer and testing agency.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 SUMMARY

A. Provide all labor and materials necessary to furnish and install vibration control systems on this project as herein specified and/or shown on the drawings.

B. Mount all mechanical equipment on suitable vibration isolators so as to prevent transmission of vibration into or through the building structure. Isolators shall be as manufactured by Mason Industries, Inc., Amber/Booth, Kenitics, or Peabody, and shall be selected by the isolator manufacturer for each item of equipment in accordance with requirements hereinafter specified.

C. The equipment manufacturer shall supply all pump and motor bases, fan and motor bases, cradles, pipe/duct hangers, spring and/or neoprene isolators, neoprene pads, flexible connectors, etc., as a coordinated package by a single manufacturer.

D. Select isolators for uniform static deflections according to distribution of weight; and for not less than the indicated isolation efficiency with the lowest rotational speed of equipment as the disturbing frequency.

E. Isolators and bases shall be stable during stopping and starting of equipment without transverse or eccentric movement of equipment, and shall be designed to resist horizontal forces of equipment which may operate unbalanced.

F. In general, select isolators on the basis of criteria as specified in the ASHRAE Applications Handbook, Latest Edition.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Indusries, or a comparable product by one of the following:
   1. Amber/Booth Company, Inc.
   2. Kinetics Noise Control.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

   1. Resilient Material: Oil- and water-resistant rubber, Mason Super W.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range, Mason Type No.

   1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
   2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Restrained Mounts: All-directional mountings with seismic restraint.

   1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
   2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

E. Spring Isolators – Mason Model SLF: Freestanding, laterally stable, open-spring isolators.

   1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
   6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

F. Restrained Spring Isolators – Mason Type SLR: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

   1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or

rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

G. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.

H. Elastomeric Hangers Mason Type HD: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

I. Spring Hangers Mason Type 30N: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
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 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

J. Spring Hangers with Vertical-Limit Stop – Mason Type PC30N: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
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 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

K. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig (3.45 MPa) and for equal resistance in all directions.

L. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 THRUST RESTRAINTS

A. Adjustable spring thrust restraints, able to resist the thrust force with at least 25 percent unused capacity. The operating spring deflection shall be not less than 50 percent of the static deflection of the isolation supporting the machinery. The spring element shall be contained within a steel frame and 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 one rod and angle bracket for attachment to both the equipment and ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrically on either side of the unit. Horizontal thrust restraints shall be Type WB.

2.3 FLEXIBLE CONNECTORS FOR PIPING

A. General: Straight flexible connectors rated for temperatures, pressures, and fluids to be conveyed. Provide flexible connectors with the strength 4 times operating pressure at highest system operating temperature. Provide elbow flexible connectors with a permanently set angle.

B. Metal Flexible Connectors: Fabricated of grade E phosphor bronze, monel or corrugated stainless steel tube covered with comparable bronze or stainless steel braid restraining and pressure cover. Sizes 3" and larger shall be flanged. Sizes 2-1/2" and smaller shall have male nipples. Lengths shall be as indicated:

NOMINAL DIAMETER (INCHES)	LENGTH (INCHES)
1/2”	9”
3/4”	10”
1”	11”
1-1/4”	12”
1-1/2”	12”
2”	12”
2-1/2”	12”
3”	18”
4”	18”
5”	18”
6”	18”
8”	18”

NOMINAL DIAMETER (INCHES)	LENGTH (INCHES)
10”	18”
12”	18”
14”	18”
16”	18”

C. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible. Hoses shall be Type BSS.

2.4 VIBRATION ISOLATION EQUIPMENT BASES

A. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries or a comparable product by one of the following:

1. Amber/Booth Company, Inc.
2. Kinetics Noise Control.

B. Steel Base: Factory-fabricated, welded, structural-steel bases and rails. Mason Type WF and Mason Type ICS.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Inertia Base- Mason Industries BMK/KSL bases with modular corners: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel modular corner brackets on frame for isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.5 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanized metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic- and wind-control devices to indicate capacity range.

2.6 ACOUSTICAL FLOOR, CEILING AND WALL SEAL:

A. Provide acoustical floor, ceiling, and wall seal where piping passes through mechanical equipment room/fan and air handling unit room walls, floors, or ceilings, and any noise-sensitive areas. The vibration isolator manufacturer shall provide a split seal consisting of two bolted pipe halves with 3/4” or thicker 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. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1" past either face of the wall. Where temperatures exceed 240^{o}F, 10# density fiberglass shall be used in lieu of the sponge. Seals shall be Type SAWS.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

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 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 will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:

1. Install seismic snubbers on HVAC 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 (3.2 mm).
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
3. Brace a change of direction longer than 12 feet (3.7 m).

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

G. 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.

H. 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.

I. 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 Division 22 for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: 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.
9. Test and adjust air-mounting system controls and safeties.
10. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust air-spring leveling mechanism.

D. Adjust active height of spring isolators.

E. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 01 Section "Demonstration And Training."

3.8 GENERAL PROVISIONS

A. Install vibration-and-noise isolation materials and equipment as indicated and in accordance with machinery manufacturer's instructions.

B. Where neoprene elements of vibration isolator may be subjected to high pipe temperatures above 160 deg F, provide metal heat shields or thermal isolators.

C. A minimum of 4" thick concrete housekeeping pads shall be provided under all floor mounted equipment. A minimum of 6" thick concrete housekeeping pads shall be provided under all air handling units, chillers, boilers and where indicated. Rest sub-bases on structural floor and reinforce with steel rods interconnected with floor reinforcing bars by tie bars hooked at both ends. Provide at least one (1) inch clearance between sub-bases and inertia bases, steel bases, and steel saddles with machinery in operation.

D. All vibration isolators exposed to weather shall be hot dipped galvanized with springs coated with neoprene.

E. Concrete inertia bases shall be a minimum of two (2) times the weight supported. Clearance between the underside of the inertia base and the housekeeping pad below shall not be less than 1 inch. Concrete shall be 3000 psi. Install inertia bases in accordance with the recommendations of the machinery manufacturer and the inertia base manufacturer.

F. Anchor Bolts and Grout: Secure machinery to foundations and inertia bases with anchor bolts. Grout equipment with baseplates, the full area under baseplates with premixed non-shrinking grout. After grout has set, remove wedges, shims, and jack bolts and fill spaces with grout.

G. Common Machinery Foundations: Mount electrical motors on the same foundations as driven machinery. Support piping connections, strainers, valves, and risers on the same foundation as the pumps.

H. Vertical Stops: For machinery affected by wind pressure or having an operational weight different from installed weight, provide resilient vertical limit stops which prevent spring extension when weight is removed. Provide vertical stops for machinery containing liquid, such as water chillers, evaporative coolers, boilers, and cooling towers. Spring isolated or protected spring isolated machinery must rock and move freely within limits of stops or seismic restraint devices.

I. Thrust Restraints: Where required, provide pairs of thrust restraints, symmetrically installed on both sides of the steady state line of thrust.

J. Machinery: Provide vibration isolators, flexible connectors and seismic snubbers in accordance with manufacturer's recommendations. Machinery with spring isolators or protected spring isolators shall rock or move freely within limits of stops or seismic snubber restraints.

K. Stability: Isolators shall be stable during starting and stopping of machinery without traverse and eccentric movement of machinery that would damage or adversely affect the machinery or attachments.

L. Lateral Motion: The installed vibration isolation systems for each piece of floor or ceiling mounted machinery shall have a maximum lateral motion under machinery start up and shut down conditions of not more than 1/4-inch. Restrain motions in excess by approved spring mountings.

M. Unbalanced Machinery: Provide foundation suspension systems specifically designed to resist horizontal forces for machinery with large unbalanced horizontal forces. Vibration isolator systems shall conform to the machinery manufacturer's recommendations.

N. Non-Rotating Machinery: Mount non-rotating machinery in systems which include rotating or vibrating machinery on isolators having the same deflection as the hangers and supports for the pipe connected to.

O. Unitized Machinery Assemblies: Unitized assemblies such as chillers with evaporator and condenser, and top mounted centrifugal compressor or unitized absorption refrigeration machines, structurally designed with end supports, may be mounted on steel rails and springs in lieu of steel bases and springs. Where the slab or deck is less than 4 inches thick, provide spring isolation units with the deflection double that of the vibration isolation schedule, up to a maximum static deflection of 5 inches.

P. Roof and Upper Floor Mounted Machinery: On the roof or upper floors, mount machinery on isolators with vertical stops. Rest isolators on beams or structures designed and installed in accordance with the SMACNA ASMM Plate 61.

Q. Vibration isolation ceiling hangers shall be installed so that the hanger rods do not touch the sides of the isolator housing, thereby seriously degrading the vibration isolation performance. Vibration isolation ceiling hangers shall be located so that the hanger housing may rotate 360^{o} without touching any object.

R. Electrical Connections: Provide flexible conduit or multiple conductor cable connections for machinery with sufficient extra length to permit 2 inch minimum displacement in any direction without damage.

S. Systems Not to be Vibration Isolated: Do not provide vibration isolation for electrical raceways and conduits or for fire protection, storm, sanitary, and domestic water piping systems which do not include pumps or other vibrating, rotating, or pulsating equipment including control and pressure reducing valves.

3.9 PIPE ISOLATION:

A. Horizontal Pipe Isolation
1. Precompressed Suspension Spring Isolators: The first three pipe hangers in the main lines near the mechanical equipment provide precompressed suspension spring isolators. Floor supported piping shall rest on trained spring isolators. All precompressed suspension spring isolators hangers or the first three trained spring isolators mounts as noted above, will have the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceiling under occupied spaces, the first three hangers shall have 0.75" deflection for pipe sizes up to and including 3", 1.5" deflection for pipe sizes up to and including 6" and 2.5" deflection thereafter. All other hangers and mounts will have a minimum steel spring deflection of 0.75". Hangers shall be located as close to the overhead supports as practical.
2. Combination Spring and Neoprene Suspension Hanger: For horizontal runs in Mechanical Equipment Rooms (including Air Handling Unit Rooms) other than those

hereinbefore specified, provide suspension spring hangers (combination spring and neoprene) with .75" minimum steel spring deflection.

B. Floor-Supported Piping:
   1. Floor supports for piping in equipment rooms and adjacent to isolated equipment shall use vibration isolators as described hereinbefore and selected to the guidelines of hangers.
   2. The first three adjacent floor supports shall be the restrained spring type with a blocking feature that prevents load transfer to equipment flanges as the piping is filled and drained.
   3. Where piping is subject to larger thermal movement a slide plate shall be installed on the top of the isolator. Slide plate shall be teflon, graphite or steel.
   4. Provide a thermal barrier where neoprene products are installed directly beneath steam or hot water lines.

C. Pipe Risers: Provide pipe riser supports with bearing plates and two layers of 1/4" thick ribbed or waffled neoprene pad loaded to not more than 50 psi. Separate isolation pads with 1/4" steel plate. Weld pipe riser clamps at anchor points to the pipe and to pairs of vertical acoustical pipe anchor mountings which shall be rigidly fastened to the steel framing.

D. Supports at Base of Pipe Risers: Piping isolation supports at the base of risers shall be two layers of 1/2" thick heavy-duty neoprene pad separated by 1/4" thick steel plate. Use bearing plates sized to provide a pad loading of not more than 500 psi. Weld the stanchion between the pipe and isolation support to the pipe and weld or bolt to the isolation support. Bolt isolation support to the floor slab with resilient sleeves and washers. Where supplementary steel is required to support piping, provide a maximum deflection of 0.08 inches at the mid-span of this steel under the load. Rigidly support piping from the supplementary steel with the supplementary steel isolated from the building structure with isolators.

E. Pipe Anchors: Attach each end of the pipe anchor to an omni-directional pipe isolator which in turn shall be rigidly fastened to the steel framing or structural concrete. Provide a telescoping pipe isolator of two sizes of steel tubing separated by a minimum 1/2" thick pad of heavy-duty neoprene or heavy-duty neoprene and canvas. Provide vertical restraints by similar material to prevent vertical travel in either direction. The load on the isolation material shall not exceed 500 psi.

3.10 EQUIPMENT ROOM SOUND ISOLATION:

A. Do not allow direct contact between pipes or ducts and walls, floor slabs, roofs, ceilings or partitions of equipment rooms.

B. Pipe Penetrations: All piping passing through Mechanical Equipment Room and Fan/Air Handling Unit Room walls, floors and ceilings shall be protected against sound leakage by means of an acoustical wall seal as described hereinbefore.

C. Duct Penetrations: Provide with sound insulation equal to the sound attenuation value of the wall, floor, or ceiling penetrated.

3.11 FLEXIBLE PIPE CONNECTORS:

A. Provide flexible connectors in accordance with Manufacturers instructions where piping systems serving vibration isolated equipment and as shown on the drawings. Flexible connectors shall be installed near the connection to the equipment. Where liquid pulsation dampening is

required, flexible connectors with spherical configuration may be used. Provide restraints for pipe connectors at pumps to prevent connector failure upon pump start-up. Flexible pipe connectors shall be twin-sphere type.

3.12 ISOLATION FOR SPECIFIC EQUIPMENT:

A. The vibration isolator manufacture shall provide isolators for all pieces of equipment provided for the job. Isolator shall be selected by the isolator manufacturer on the basis of criteria as specified in the latest edition of ASHRAE Applications Handbook, unless a more stringent requirement is indicated on the drawings.

B. Cabinet/In-Line Fan(s): Suspended – Provide combination spring and neoprene type isolator with a minimum deflection of 1½"; Mason Industries Type 30N, or approved equal.

C. Cabinet Unit Heaters (Ceiling Hung Type): Provide combination spring and neoprene isolator, Mason Type W30, at 1.00” minimum deflection.

3.13 DUCTWORK

A. All ductwork shall be provided with spring deflection hangers (50 feet maximum from air handling unit connection). Spring deflection shall be a minimum of 0.75”.

END OF SECTION 23 05 48

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.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

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 with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), 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.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus 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, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), 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

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, snap-on semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive (4" and less). For larger pipe (sizes 6" and greater) markers shall be strapped around using nylon ties.

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.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME (ANSI) A13.1 for piping; minimum letter height of 1-1/4 inches (32 mm) for ducts; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Aluminum.
2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME (ANSI) A13.1 unless otherwise indicated.

B. Duct Identification Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) black-filled letters for piping system abbreviation and 1/2-inch (13-mm) numbers; 2-inch diameter.

1. Tag Material: Brass, 19-gauge, minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass jack chain and/or brass S Hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) 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.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 4 by 7 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09.

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 (ANSI) A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. 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 for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit 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.
8. Where pipes are adjacent to each other, markings shall be neatly lined up. All markings shall be located in such a manner to be easily legible from the floor.
9. For piping less than 3/4-inch, provide permanently legible tag as specified hereinbefore for valve identification.
10. For buried piping, provide 2-inch minimum width plastic identification/detection tape with metallic core. Install 4-6-inches below-grade.

D. Pipe Label Color Schedule:

1. Refrigerant Piping:

a. Background Color: Black.
b. Letter Color: White.

3.4 DUCT LABEL IDENTIFICATION

A. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, shall be provided.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 25 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:
   a. Refrigerant: 2 inches (50 mm), round.

2. Valve-Tag Color:
   a. Refrigerant: Natural.

3. Letter Color:
   a. Refrigerant: Black.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 23 05 53

SECTION 230700 - HVAC INSULATION

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. Insulation Materials:
   a. Flexible elastomeric.
   b. Mineral fiber.
2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Lagging adhesives.
7. Sealants.
8. Factory-applied jackets.
9. Field-applied fabric-reinforcing mesh.
10. Field-applied cloths.
11. Field-applied jackets.
12. Tapes.
13. Securements.
14. Corner angles.

B. Related Sections:
1. Division 22 Section "Plumbing Insulation."
2. Division 23 Section "Metal Ducts" for duct liners.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.

6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.

1. Sample Sizes:

a. Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN 50).
b. Sheet Form Insulation Materials: 12 inches (300 mm) square.
c. Jacket Materials for Pipe: 12 inches (300 mm) long by NPS 2 (DN 50).
d. Sheet Jacket Materials: 12 inches (300 mm) square.
e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

D. Qualification Data: For qualified Installer.

E. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

F. Field quality-control reports.

1.4 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. Fire-Test-Response Characteristics: Insulation and related materials shall 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, tapes, 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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. 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: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Duct Wrap.
d. Owens Corning; All-Service Duct Wrap.

H. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; HTB 23 Spin-Glas.
b. Owens Corning; High Temperature Flexible Batt Insulations.

I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Commercial Board.
b. Fibrex Insulations Inc.; FBX.
c. Johns Manville; 800 Series Spin-Glas.
d. Knauf Insulation; Insulation Board.
e. Manson Insulation Inc.; AK Board.
f. Owens Corning; Fiberglas 700 Series.

J. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Fibrex Insulations Inc.; FBX.
b. Johns Manville; 1000 Series Spin-Glas.
c. Owens Corning; High Temperature Industrial Board Insulations.
d. Rock Wool Manufacturing Company; Delta Board.
e. Roxul Inc.; Roxul RW.
f. Thermafiber; Thermafiber Industrial Felt.

K. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000 Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied -SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Type II, 1200 deg F (649 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied -SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; CrimpWrap.
b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation.
d. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F (927 deg C). Comply with ASTM C 656, Type II, Grade 6. tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.

1. Products: Subject to compliance with requirements, provide the following:

a. Johns Manville; Super Firetemp M.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; FlameChek.
b. Johns Manville; Firetemp Wrap.
c. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
d. Thermal Ceramics; FireMaster Duct Wrap.
e. 3M; Fire Barrier Wrap Products.
f. Unifrax Corporation; FyreWrap.

2.3 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. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.
d. RBX Corporation; Rubatex Contact Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Chemical Company (The); 739, Dow Silicone.
b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Speedline Vinyl Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.

c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-30.
b. Foster Products Corporation, H. B. Fuller Company; 30-35.
c. ITW TACC, Division of Illinois Tool Works; CB-25.
d. Marathon Industries, Inc.; 501.
e. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; Encacel.
b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
c. Marathon Industries, Inc.; 570.
d. Mon-Eco Industries, Inc.; 55-70.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-10.
b. Foster Products Corporation, H. B. Fuller Company; 35-00.
c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
d. Marathon Industries, Inc.; 550.
e. Mon-Eco Industries, Inc.; 55-50.
f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms (2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.

3. Service Temperature Range: Minus 20 to plus 200 deg F (Minus 29 to plus 93 deg C).
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-52.
    b. Foster Products Corporation, H. B. Fuller Company; 81-42.
    c. Marathon Industries, Inc.; 130.
    d. Mon-Eco Industries, Inc.; 11-30.
    e. Vimasco Corporation; 136.

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 (Minus 46 to plus 82 deg C).
5. Color: White.

2.6 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-76-8.
    b. Foster Products Corporation, H. B. Fuller Company; 95-44.
    c. Marathon Industries, Inc.; 405.
    d. Mon-Eco Industries, Inc.; 44-05.
    e. Vimasco Corporation; 750.

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 (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, Vinyl, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-76.

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 (Minus 40 to plus 121 deg C).
5. Color: White.

6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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: White, kraft-paper, or paper-free (Owens Corning Evolution) fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the work, but are not limited to, the following::

    a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 20 mil thickness; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

    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, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

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 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.

a. Factory cut and rolled to size.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
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.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

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.

2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) 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.

1. Products: Subject to compliance with requirements, provide one of the following:

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.

2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) 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: Subject to compliance with requirements, provide one of the following:

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.

2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

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.

2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.11 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

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 304 or 316; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide with wing or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm), 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. Cupped-Head, Capacitor-Discharge-Weld Pins: Stainless steel- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) AGM Industries, Inc.; CWP-1.
        2) GEMCO; Cupped Head Weld Pin.
        3) Midwest Fasteners, Inc.; Cupped Head.
        4) Nelson Stud Welding; CHP.

2. 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: Subject to compliance with requirements, provide one of the following:

        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 (0.76 mm) thick by 2 inches (50 mm) square.
    c. Spindle: Zinc-coated, low carbon steel, aluminum or stainless steel, fully annealed, 0.106-inch- (2.6-mm-) 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.

3. Insulation-Retaining Washers: Self-locking washers formed from 0.015-inch- thick, galvanized-steel or stainless steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

    a. Products: Subject to compliance with requirements, provide one of the following:

        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.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy or 0.062-inch (1.6 mm) soft annealed stainless steel..

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.
b. Childers Products.
c. PABCO Metals Corporation.
d. RPR Products, Inc.

2.12 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL 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. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, 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.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) 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.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. 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.

Q. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance such as vessel covers, fasteners, flanges, frames and accessories.

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 (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground 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 (50 mm).
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 (50 mm).

1. Comply with requirements in Division 07 Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.

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 (50 mm).
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. 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.
3. Protect exposed corners with secured corner angles.
4. 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 (75 mm) from insulation end joints, and 16 inches (400 mm) 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.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. 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 (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) 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 (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches (75 mm).
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. 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.

C. Insulation Installation on Pumps:

1. For chilled water pumps fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) 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 0.040 inch (1.0 mm) 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. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular

surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe 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 insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or reusable valve wraps. 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.
10. Heating hot water coil piping trim to terminal units (blower coil units, VAV units) does not need to be insulated if located a minimum of three (3) feet from the coil when located in air conditioning ductwork.
11. Insulate all heating coils and all connecting piping within 3 feet of coil when located in air conditioning ductwork.
12. All valve stems shall be sealed with caulking.
13. Provide removable/flexible insulation covers with draw string ends and Velcro fastener for chilled water control valves (i.e., fan coil units). Covers shall be as manufactured by NoSweat Reusable Valve Wraps or equal.

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 (50 mm) 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 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 reusable valve wrap covers.
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.

3.8 MINERAL-FIBER 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.

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 (150 mm) 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 (25 mm), 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 adhesive and 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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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 (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) 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 (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) 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- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and 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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
   b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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 (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) 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 (75 mm).

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- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.9 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 (50-mm) overlap at seams and joints.
    2. Embed glass cloth between two 0.062-inch- (1.6-mm-) 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 (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) 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 (25-mm) 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 (50-mm) 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 (300 mm) o.c. and at end joints.

3.10 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.11 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

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 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.13 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return/relief.
4. Indoor, exposed return/relief.
5. Indoor, relief / exhaust downstream from heat recovery units/devices.
6. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
7. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
8. Outdoor, concealed supply and return.
9. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1, unless otherwise indicated.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.
8. Return air ducts located in conditioned spaces including in classrooms with cloud type ceilings where the occupied space is open to above ceiling clouds.

3.14 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2 inches (51 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

B. Concealed, round and flat-oval, return-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2 inches (51 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

C. Concealed, round and flat-oval, outdoor-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2 inches (51 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

D. Concealed, round and flat-oval, exhaust-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2 inches (51 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

E. Concealed, rectangular, supply-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2 inches (51 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

F. Concealed, rectangular, return/relief-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches (51 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

G. Concealed, rectangular, outdoor-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2 inches (51 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

H. Concealed, rectangular, exhaust-air duct insulation from heat recovery units and all exhaust air duct insulation between isolation damper and penetration of building exterior shall be the following:
1. Mineral-Fiber Blanket: 2 inches (51 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

I. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

J. Concealed, supply-air plenum insulation shall be the following:
1. Mineral-Fiber Blanket: 2 inches (51 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

K. Concealed, return/relief-air plenum insulation shall be the following:
1. Mineral-Fiber Blanket: 2 inches (51 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

L. Concealed, outdoor-air plenum insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches (51 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

M. Concealed, exhaust-air plenum insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches (51 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

N. Exposed, round and flat-oval, supply-air duct insulation shall be the following:

1. Exposed ductwork in occupied spaces does not require external insulation. Exposed ductwork shall be double wall pre-insulated.

O. Exposed, round and flat-oval, return-air duct insulation shall be the following:

1. Exposed ductwork in occupied spaces does not require external insulation. Exposed ductwork shall be double wall pre-insulated.

P. Exposed, round and flat-oval, outdoor-air duct insulation shall be the following:

1. Exposed ductwork in occupied spaces does not require external insulation. Exposed ductwork shall be double wall pre-insulated.

Q. Exposed, round and flat-oval, exhaust-air duct insulation shall be the following:

1. Exposed ductwork in occupied spaces does not require external insulation. Exposed ductwork shall be double wall pre-insulated.

R. Exposed, rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

S. Exposed, rectangular, return/relief-air duct insulation shall be the following:
1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

T. Exposed, rectangular, outdoor-air duct insulation shall be the following:
1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

U. Exposed, rectangular, exhaust-air duct insulation shall be the following:
1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

V. Exposed, supply-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

W. Exposed, return/relief-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

X. Exposed, outdoor-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

Y. Exposed, exhaust-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

Z. Concealed supply air and return/relief air insulation for roof-mounted air handling/heat recovery units shall be the following for the first ten (10) feet of the unit connection:
1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

AA. Exposed ductwork located in mechanical penthouses shall be considered as concealed.

3.15 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.16 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
   b. Flexible Elastomeric: 1 inch (25 mm) thick.

B. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1 inch (25 mm) thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

   a. Flexible Elastomeric: 1 inch (25 mm) thick.

3.17 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 2 inches (50 mm) thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

   a. Flexible Elastomeric: 2 inches (50 mm) thick.

3.18 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

1. None.

D. Ducts and Plenums, Exposed to the Occupied Space:
1. PVC 20 miles (0.5 mm) thick

E. Equipment, Concealed:

1. None.

F. Equipment, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):
1. none

G. Equipment, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):
1. none

H. Piping, Concealed:

1. None.

I. Piping, Exposed to the Occupied Space:
1. PVC: 20 mils (0.5 mm) thick.

3.19 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:
1. Exterior refrigerant piping tubing shall be provided with an aluminum jacket or AIREX EFLEX Guard or equal.

END OF SECTION 23 07 00

SECTION 230900 – INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - RELATED DOCUMENTS

1.1 SUMMARY:

A. For General Mechanical Requirements, see Section 15100, General Mechanical Requirements, apply to all work in this Section.

B. Comply with all code requirements and fire safety requirements as specified in Section 15100.

C. The Automatic Temperature Control System (ATC), tie-in to existing, and Central Control and Monitoring System shall be BACNET-BTL certified, WEB-based, electric/electronic actuation, direct digital control (DDC) Tridium with Johnson Controls Facility Explorer open architecture. Tridium Niagara AX Framework (open Protocal and open NIC only). Specific supervisory and unitary controllers only. All controllers shall be programable and interlocked with the existing County EMS or at the Contractors option be.

D. Coordinate controls with controlled equipment. Upon completion of the work, calibrate and adjust all controls for proper function. Electric wiring, including interlock wiring for equipment such as air handlers, fans, etc., shall be furnished and installed under this section. All electrical work shall conform to the applicable requirements of Division 16. All control wiring shall be installed in conduit in accordance with Division 16, except for control wiring located above accessible ceilings, which shall be plenum-rated cable.

E. All automatic temperature control dampers, valves and separable wells for immersion elements furnished by the Control Manufacturer shall be installed by the Mechanical Contractor or his sheet-metal subcontractor under the Control Manufacturer's supervision.

F. Reference is hereby made for this Contractor to become familiar with Division 16 of these specifications. Familiarization is for coordination purposes only. The Control Contractor shall provide all necessary relays, contacts, interlock wiring etc. not provided under Division 16 for the automation of the ATC and EMS systems as required by the sequence of operation and input/output schedule. The Control Contractor shall coordinate all requirements with the building Fire Alarm System. The Control Contractor shall provide all additional devices and interlock wiring required for the automation of the ATC system and monitoring of the EMS system.

G. Provide all labor, materials, equipment and services necessary for and incidental to furnishing and installing a complete stand-alone electric/electronic automatic temperature control system to meet the requirements of the sequence of operation described in Section 3.3.

H. The Control Contractor shall provide control and monitoring system devices and sensors that conform to the standards of NFPA 72D. Confirmation of compliance shall be UL Listings 864 and 1076 for systems specified. Pending UL Listings shall not be accepted. Proof of UL Listing (by model number) shall be submitted to the Engineer with equipment submittal. Devices and sensors shall be provided to suit the function of the Input/Output Point Summary shown on the contract drawings.

I. The ATC Contractor shall coordinate with Division 15, Mechanical, and shall furnish and install all items necessary to meet the requirements of the Sequence of Operation and the Energy Management System (EMS) indicated on the drawings and as required in this specification. The ATC Contractor shall coordinate all devices, sensors, interlocks, interfaces, I/O Require

ments, and programming as required to meet the Sequence of Operations. Redundant controllers are prohibited. The ATC Contractor shall meet with the boiler factory controls representative to coordinate these requirements. Additionally, at the time of Shop Drawing development, the ATC Contractor and boiler Representative shall have a Coordination Meeting at the Engineer's Office to coordinate requirements.

J. The control system shall include all necessary and specified control equipment properly installed in accordance with the specifications and drawings and shall include, but not be limited to the automatic temperature control and energy management system of the following:

1. All fan coil units and ERV's
2. General ventilation air systems
3. All terminal units (CUH's, UH's etc.)
4. Miscellaneous Interlock Wiring for Fan Speed Switches, liquid level sensors, Flow meters, air cooled condensing units, etc.
5. Connection to existing or new Web-Based Energy Management System and associated hardware and software for a fully automated remote system.

K. The ATC Contractor shall provide input/output devices and sensors, conduit system and interlock wiring between sensors and the existing Energy Management System. All sensors and devices provided for tie-in to the existing Energy Management System.

L. EMS:

1. Work includes modification of the existing Energy Management System and the furnishing and installing of all hardware, software and accessories required to perform the functions listed and as described hereinafter in the sequence of operation.
2. The Contractor shall modify and extend the existing Energy Management System to enable the expansion of the system to include the monitoring and control of the items indicated in the control point schedule (I/O Summary) and listed in these contract documents and specifications.
3. The Contractor shall provide programming to incorporate the new points into the data file of the existing CPU.

M. The building shall be provided with stand-alone local controls, which shall interface with the remote Energy Management System. The Energy Management System shall override local controls when "Local-Remote" System switches are in the remote position. Position of all "Local-Remote" switches shall be monitored by the Energy Management System. If failure of the Energy Management System occurs when the "Local-Remote" System switch is indexed to remote control, all controls functions shall revert back to local controls. Reset to remote controls shall be manual. Provide an "occupied – unoccupied" override touch screen control panel in the main office which can be used to override the EMS for each zone. Coordinate requirements and location with the Owner.

N. All controls shall communicate over Ethernet connections.

O. Provide dedicated circuits for ATC/EMS controllers, control panels, etc. Coordinate location with Division 26. Provide dedicated 120v circuits for ATC/EMS controllers, control panels where not provided by Division 26. Coordinate location of these additional dedicated circuits required by the ATC/EMS with Division 26.

P. Each DDC Controller shall communicate over a BACnet communications bus installed between the controllers by the ATC subcontractor. This panel shall:

1. Provide SMCPS personnel with a convenient location to obtain system information using a laptop or hand-held terminal.
2. Collect ATC information and transmit it to the main ATC panel.
3. Receive energy management directions from the main ATC panel.

Q. Within 10 working days of Contract Award, a meeting shall be scheduled with SMCPS, the Engineer, and the Controls Contractor. The purpose of the meeting will be to develop the sequences, point lists, and interfaces necessary to reduce the number of issues.

R. If an existing ATC system is being removed, the Contractor shall remove all wiring and other equipment and all old I/O points associated with that system from all servers. SMCPS shall have first salvage rights for all equipment being removed.

S. All controllers, sensors, and switches shall be hard wired. All connections between the main ATC panel and sub-panels / controllers shall be hard wired. Wiring shall be installed in accordance with Building and Electrical codes, as well as any other applicable codes.

T. All equipment shall have a RIB switch relay override for service and troubleshooting.

U. Sensors, not thermostats, shall be used to read temperature in spaces and shall have a range of 0° F to 120° F.

V. All equipment shall be controlled by a stand-alone DDC controller. Theses controllers shall be provided and field installed by the ATC Contractor. The ATC system shall only enable these pieces of equipment which are expected to run “stand alone”. Factory controllers will not be acceptable

W. The data transmitted from the ATC system to the Command Center shall include the following as a minimum:

1. Equipment Information:
   a) Start/Stop signals for all equipment.
   b) Summer/winter single point switch-over capability.
   c) Adjustable reset schedules.

2. General Information:
   a) Outside Air Temperature.
   b) Alarm Data

3. Zone Information
   a) All True Fan Status (On/Off/Speed) –
      - Read differential pressure for water
      - Read status and safeties for air.

   b) Zone Temperature as measured by Zone Sensor
   c) Override Status
   d) Alarm Data (i.e. readings outside of normal system parameters)
      - Temperature +/- 10° from set point for ½ hour.
   e) CO2 Level of Zones
   f) Discharge and Return Air for Zones with constant volume and variable volume Air Handling Units.
   g) Equipment Status (Default/Open/Off)

1.2 WORK BY OTHERS:

A. Automatic temperature control valves and separable wells for immersion elements furnished by the control manufacturer shall be installed by the Mechanical Contractor under the manufacturer's supervision. The Control Contractor shall deliver to the Mechanical Contractor valves and wells for installation within the various systems. All controls with remote sensors where they are reading water or air temperatures shall be mounted in a sensor well.

B. All automatic dampers furnished by the control manufacturer shall be installed by the Mechanical Contractor under the control manufacturer's supervision.

1.3 QUALITY ASSURANCE:

A. Supplier shall have an in-place support facility with technical staff, spare parts inventory and all necessary test and diagnostic equipment.

B. The systems shall be complete in all respects, and shall be installed by skilled personnel. The Control Contractor shall have a successful history in the installation and maintenance of automatic temperature control systems similar in size and performance to that specified herein.

C. All electrical wiring in connection with the Automatic Temperature Control System shall be furnished and installed by the ATC Contractor. This shall include all interlock wiring between fans, heaters, terminal control units, etc.

1.4 GUARANTEE AND INSTRUCTION:

A. The building control system (ATC) including all components, system software, parts and assemblies herein specified shall be free from defects in workmanship and materials under normal use and service. After completion of the installation, the Control Manufacturer shall regulate and adjust all thermostats, control valves, control motors, and other equipment provided under this contract. If, within two (2) years from the date of acceptance by Owner, any of the equipment herein described is proved to be defective in workmanship or materials, it will be replaced or repaired at no additional cost to the Owner. The Control Manufacturer shall, after completion, provide any service incidental to the proper performance of the Control System under guarantees outlined above for a period of two (2) years after substantial completion of the entire project. Provide a two (2) year warranty for the energy management system (EMS). The contractor shall replace and/or repair defective EMS hardware (Sensors, micro-processors, transducers, relays, etc.) in response to notification by St. Mary’s County Public Schools. Where a failure has occurred that necessitates reloading of software, the work shall be performed by this contractor. Final control devices such as valves, dampers, actuators, etc. shall fall under the two (2) year ATC warranty. For the end of the warranty the controls contractor shall arrange to meet with the EMS engineer and owner within thirty (30) days prior to the specified end of the 2-year guarantee period for the purpose of compiling a list of items that require correction under the specified guarantees. Should the contractor fail to schedule the final meeting then the 2-year controls system guarantee shall be automatically extended until such time as the meeting takes place and the contractor shall be fully responsible for correcting such deficiencies as if they occurred under the original guarantee period. Normal maintenance of the system is not to be considered part of the guarantee. All corrective modifications made during warranty service periods shall be updated on all user documentation including "as-built" shop drawings and on user and manufacturer archived electronic media disks.

B. Software Upgrades: Over the five (5) year EMS guarantee period, the contractor shall provide and install all software upgrades released by the manufacturer as applicable to the systems installed.

C. The Control Contractor shall completely check out, calibrate and test all connected hardware to insure that the system performs in accordance with the approved specifications and sequences of operation submitted.

D. Upon completion of the work, the control drawing encased in heavy plastic shall be provided where directed. Layout shall show all control equipment and the function of each item indicated.

E. Upon completion of the work, the Control Contractor shall have completely adjusted the entire control system. He shall arrange to instruct the Owner's representative on the operation of the control system for a period of not less than three (3) eight (8) hour days. All training shall be by the Control Contractor and shall utilize specified manuals and as-built documentation. In addition to the start-up instructional period the ATC Contractor shall provide one (1) eight hour instructional period 6 months after the initial instructions and one (1) eight hour instructional period 12 months after the initial instructions (i.e. one during cooling season/one during the heating season). Provide two (2) DVD ROM or flash drive/external hard drive video recorded copies of all instructional periods and demonstrations.

1.5 SUBMITTALS:

A. Submit complete shop drawings, including component catalog cuts, for approval before starting any control work. Shop drawings shall be in accordance with Section 230500. Shop drawings shall indicate all control equipment, arrangements, locations, functions, and description of operation.

B. Upon completion of his work, the Control Contractor shall provide six (6) sets of description of operation and schematic drawings corrected to the as-built condition. This material shall be delivered to the Owner.

C. Submittal shall consist of:

1. Data sheets of all products.
2. Valve, damper, and well and tap schedules showing size, configuration, capacity and location of all equipment.
3. Wiring and piping interconnection diagrams including panel and device power and sources.
4. Equipment lists of all proposed devices and equipment.
5. Sequences of Operation.
6. Controls Systems Network Architecture and Riser Diagrams including all nodes, devices, interfaces and interconnections.
7. Schematics, sequences, and logic diagrams.
8. Descriptions and/or product data sheets for all equipment, materials, software, firmware components and items to be furnished and provided. Information shall be project specific and not general advertising.
9. The estimated detailed Bill of Material for the Project.
10. Details of all coordinated interfaces between both Controls Systems Applications and the associated work of other trades.
11. Point Lists for all physical and virtual (software) points to be provided at minimum including for each Point the Tag, Type, Range, Units Descriptor, Address, Project specific attributes and the like.
12. Include in the Points List details of the physical terminations and interconnections for each end device on the networks, including the associated Node, cable terminations, termination location and referenced sequences, special functions to be applied and cross-referenced drawings. All field wiring tags shall be cross-referenced between drawings.

13. Information specifically required by AHJ.
14. Details of the training to be provided, including outlines for each session.
15. Details of the commissioning sheets and procedures proposed.
16. Details of telephone line, ISP, and associated requirements to be provided by the Owner, at its cost, in order for the Contractor to complete the work.
17. Final graphic floor plan with final room numbers.
18. All St. Mary's County Public School Standard acronyms.

1.6 PLACING IN SERVICE AND ACCEPTANCE

A. EMS Contractor shall be present and participate in the start-up of the heating system. Control sequences of operations and coordination of interlocks with equipment manufacturers' controls/safeties shall be demonstrated to the satisfaction and acceptance of the Owner, the design team, and the commissioning authority.

B. Prior to final acceptance and authorization for final payment by the Owner, Control System inspections shall be made by the EMS Engineer, Mechanical Design Engineer, and representatives of the Owner's construction, maintenance, and energy management departments. The inspection shall be in four parts. An inspection shall be performed regarding the physical installation of the EMS equipment, wiring, etc. a separate inspection regarding head-end (graphics) software programming; and on-site software programming and controls system performance verification shall be performed in both cooling and heating seasons. Any deficiencies discerned during one inspection shall be corrected prior to performing the subsequent inspection.

C. On-site performance verification shall be preceded by trends submissions by the contractor with review and comment by the EMS consultant. Trending shall be presented at hourly intervals for a 24 hour period, unless directed otherwise. Systems being monitored shall be operated with an occupancy schedule; i.e. indications that a system was scheduled off for the 24 hours of the history and remained off are of no value. Occupancy schedule and all system setpoints (both calculated and manual inputs) shall be provided with the histories. To assure that trends suitably demonstrate appropriate operations, heating trends shall be run when outdoor air drops to an occurrence of at least 35ºF during the trend period, cooling season trends can be run whenever outdoor air rises to an occurrence of a least 85ºF during the trend period.

D. For the end-of warranty, the Controls Contractor shall arrange to meet with the EMS Engineer and the Owner within thirty (30) days prior to the specified end of the 2-year guarantee period for the purpose of compiling a list of items that require correction under specified guarantees. Should the Contractor fail to schedule the final meeting, then the 2-year controls system Guarantee shall be automatically extended until such time as the meeting takes place; and the Contractor shall be fully responsible for correcting such deficiencies as if they occurred under the original guarantee period.

1.7 EMS/TAB COORDINATION: In addition to routine coordination between controls contractor and test and balancing contractor, EMS contractor shall:

A. Obtain true systems setpoints for the TAB contractor, including:

1. Piping system differential pressure setpoints for controlling pumps' VFDs.

1.8 ENERGY MANAGEMENT ROUTINES/GLOBAL OPERATIONS: The following energy management routines are to be provided:

A. OPTIMIZED START: Optimized start programs shall be accomplished by monitoring outdoor temperature, individual space temperature, and historical data of the building recovery time. The program shall automatically evaluate the thermal inertia of the structure, the capacity of the

HVAC system to either increase or reduce space temperatures, indoor and outdoor conditions to determine the minimum time of HVAC system operation needed to satisfy the space environmental requirements at the start of the occupied cycle. The program shall monitor the controlled equipment status to verify that the start command was carried out, and provide an alarm when the equipment does not start, fails, or is locally overridden. Each piece of equipment shall perform optimized start individually responsive to its space temperature; indicate such on the Input/Output Summary Tables (Points Lists).

B. TIME PROGRAMMED COMMANDS (TPC):

1. The TPC program shall reduce the heating space temperature setpoint and raise the cooling space temperature setpoint during unoccupied hours. The software shall limit the amount of setback during periods of extremely cold weather to facilitate morning warm-up and prevent freeze-ups. Setback shall initially be set with the scale of 55ºF indoors at outdoor air temperatures of 50ºF and warmer and 60ºF indoors at 25ºF or colder outdoor air temperatures. Set-up temperature shall be 90ºF. Systems not capable of mechanical cooling shall not perform night set-up.
2. Provide software to reduce the HVAC thermal load during warm-up or cool-down cycles prior to the occupancy of the building. Heating-only units shall not perform cool-down.

C. PHASE AND VOLTAGE MONITORING: EMS shall monitor incoming electrical power to the building. In the event of any problem with voltage or phasing, the EMS shall display an alarm and log irregularities.

PART 2 - PRODUCTS

2.1 CONTROLS SYSTEM ARCHITECTURE

A. General

1. The Controls Systems shall consist of multiple Nodes and associated equipment connected by industry standard digital and communication network arrangements.
2. The Operator Workstations, Servers and principal network computer equipment shall be standard products of recognized major manufacturers available through normal PC and computer vendor channels – not “Clones” assembled by a third-party subcontractor.
3. Provide licenses for all software residing on and used by the Controls Systems and transfer these licenses to the Owner prior to completion.
4. The networks shall, at minimum, comprise, as necessary, the following:

    a. Operator Workstations – fixed and portable as required by the Specifications.
    b. Network computer processing, data storage and communication equipment including Servers and digital data processors.
    c. Routers, bridges, switches, hubs, modems, interfaces and the like communication equipment.
    d. Active processing network Application Nodes including programmable field panels and controllers together with their power supplies and associated equipment.
    e. Addressable elements, sensors, transducers and end devices.
    f. Third-party equipment interfaces as required by the Contract Documents.
    g. Other components required for a complete and working Control Systems as specified.

5. The Specifications for the individual elements and component subsystems shall be minimum requirements and shall be augmented as necessary by the Contractor to achieve both compliance with all applicable codes, standards, the requirements of the Authorities Having Jurisdiction (AHJ) at the site and to meet all requirements of the Contract Documents.

B. Network

1. The Controls Systems shall incorporate primary Tier 1 network(s). At the Controls Contractor's option, they may also incorporate multiple and integrated secondary Tier 2 and tertiary Tier 3 networks.
2. The networks shall utilize only copper and optical fiber communication media as appropriate and to comply with the applicable codes, ordinances and regulations and the Authorities Having Jurisdiction (AHJ). They may also utilize digital wireless technologies if required by the Project and approved by the Architect and the Authorities Having Jurisdiction (AHJ).
3. The Owner shall provide all private and public telephones lines, ISDN lines and Internet Service Provider services and connections as necessary for the Controls Contractor to complete the work as contracted at the Owner's direct cost. The Controls Contractor shall identify the specific requirements in a shop drawing submittal.
4. The Controls Contractor shall provide all IT interfacing equipment and cabling to a detail coordinated with the Owner.

C. Third-Party Interfaces

1. Controls Contractor shall integrate real-time data from building systems by other trades and databases originating from other trades as specified and required by the Contract Documents and Part 3 herein.
2. The Controls Systems shall include necessary hardware, equipment and software to allow data communications between the Controls Systems and building systems supplied by other trades.
3. The other trade contractors supplying other associated systems and equipment will provide their necessary hardware and software at their cost and will cooperate fully with the Controls Contractor in a timely manner and at their cost to ensure complete functional integration.
4. The Controls Contractor shall not be responsible for the execution or the scheduling of the work of other trades or Divisions.

2.2 OPERATOR INTERFACES

A. General

1. The Controls Systems Operator Interfaces shall be user friendly, readily understood and shall make maximum use of colors, graphics, icons, embedded images, animation, text based information and data visualization techniques to enhance and simplify the use and understanding of the displays by authorized users at the OWS.
2. User access shall be protected by a flexible and Owner redefinable software-based password access protection. Password protection shall be multi-level and

partitionable to accommodate the varied access requirements of the different user groups to which individual users may be assigned. Provide the means to define unique access privileges for each individual authorized user. Provide the means to on-line manage password access control under the control of a project specific Master Password. Provide an audit trail of all user activity on the Controls Systems including all actions and changes.

3. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
   a. User access for selective information retrieval and control command execution.
   b. Monitoring and reporting.
   c. Alarm and non-normal condition annunciation.
   d. Selective operator override and other control actions.
   e. Information archiving, manipulation, formatting, display and reporting.
   f. Controls Systems internal performance supervision and diagnostics.
   g. On-line access to user HELP menus.
   h. On-line access to current as-built records and documentation. At minimum, one (1) copy of all record documentation shall be stored on a designated OWS or Server and be accessible to the Owner.
   i. Means for the controlled re-programming, re-configuration of systems operation and for the manipulation of database information in compliance with the prevailing codes, approvals and regulations for the component applications and elements.
   j. Means to archive all Controls Systems Contract Project specific configuration databases, software programs and other pertinent operational data such that any component of the software and project specific operational databases may be reloaded on-site from archived data.
4. Provide on-line reports and displays making maximized use of simple English language descriptions and readily understood acronyms, abbreviations, icons and the like to assist user understanding and interpretation. All text naming conventions shall be consistent in their use and application throughout the Controls Systems. Submit proposed naming arrangements for approval prior to data entry.

B. All devices, including OWS, Servers and Application Nodes, required to support and drive the Operator Interfaces shall support multiple independent user terminals through a theoretical unlimited number of Browsers. Support shall be configured for a minimum of 25 users for all Applications and features provided.

2.3 CONTROLS SYSTEMS APPLICATIONS – GENERAL

A. General
1. The Controls Systems Application Nodes (AN) shall include all monitoring, control and data handling Nodes including programmable field panels and controllers.
2. AN shall be programmable and governed by the requirements of their applicable codes, approvals and regulations for their Application.
3. The AN shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions.

They shall be proven standard product of their original manufacturer and not a custom product for this Project.

4. A failure at an AN shall not cause failures or non-normal operation at any other system AN other than the possible loss of active real-time information from the failed AN.
5. Ancillary AN equipment, including interfaces and power supplies, shall not be operated at more than 80% of their rated service capacity.
6. AN shall comply with FCC Part 15 subpart J Class A emission requirements.
7. AN shall maintain all programming in non-volatile or battery backed memory and shall automatically resume normal monitoring and control following the restoration of stable electrical power after a power outage.

2.4 CONTROLS SYSTEMS APPLICATION – SPECIFICS:

A. General

1. The Controls Systems shall be designed and implemented entirely for use and operation on the Internet and the Owner's Intranet. This functionality for operational access shall extend down to the field panel and field point level.
2. The primary Controls Systems Nodes (AN) shall be fully IT compatible nodes operating over the industry standard IT infrastructure provided for the Project. The Controls Contractor shall coordinate with the IT infrastructure support staff or trade contractors to ensure compatibility and performance of the operation of the Controls Systems over the LAN/WAN made available for its shared use.
3. The Controls Systems Tier 1 network shall be configured on IT industry standard off-the-shelf technologies compatible with other building systems and Project network arrangements.
4. All aspects of the Controls Systems Operator Interface shall be provided to operate through an IT industry standard Web Browsers such as Internet Explorer or Netscape or approved equivalent.
5. The Web Browser based Operator Interface provided shall incorporate complete tool sets, operational information displays, multi-Window displays and other interactive aids to assist interpretation and ease of use. Simple HTML based web page displays are not acceptable.
6. The Web Browser based Operator Interface provided shall not require the procurement or licensing of any special or proprietary software from the Controls Contractor or its suppliers for the Controls Systems OWS.
7. As required for the functional operation of the Controls Systems, the Controls Contractor shall provide all necessary digital processor programmable Server(s). These Server(s) shall be utilized for Controls Systems Application configuration, for archiving, reporting and trending of data, for Operator transaction archiving and reporting, for network information management, for alarm annunciation, for Operator Interface tasks, for Controls Application management and the like. These Server(s) shall utilize IT industry standard data base platforms such as Microsoft SQL Server and Microsoft Data Engine (MSDE) or approved equal.
8. Provide a fully distributed processing, on-line, real-time, direct digital control Controls Systems Application in compliance with all applicable codes and as approved by the Authorities Having Jurisdiction (AHJ) at the Project site. All communication between Controls Application Nodes shall be digital only.

9. All Controls Systems Application facilities and features shall be accessible via Enterprise Intranet and Internet Browser with user ID or Password access control for user access.
10. The Controls Systems Application shall support auto-dial/auto-answer communications to allow Controls Systems Nodes to communicate with other remote Controls Systems Nodes via standard telephone lines. Refer to drawings for type of line to be used, DSL or voice grade. Where no preference is indicated then DSL will be provided. The lines shall be provided by the Owner at the Owner's cost.
11. The Controls Systems Application network shall utilize an open architecture capable of each and all of the following:
    a. Utilizing standard Ethernet communications and operate at a minimum speed of 10/100 Mb/sec.
    b. Connecting via BACnet at the Tier 1 level in accordance with ANSI/ASHRAE Standard 135-2001.
12. Downloading and Uploading:
    a. Provide the capability to generate and modify the Controls Systems Application software-based sequences, database elements, associated operational definition information and user-required revisions to same at any designated Workstation together with the means to download same to the associated Controls Systems Application Node.
    b. The Controls Systems Application software tool provided for the generation of custom and database definitions shall be resident in both the Controls Systems Application Node and Controls Systems Application Server(s).
    c. Provide the capability to upload Controls Systems Application operating software information, database items, sequences and alarms to designated Server(s).
    d. The functions of this Part shall be governed by the codes, approvals and regulations applying to this Controls Systems Application as provided.
13. The Controls Systems Application Portable OWS shall operate identically and have equal functionality to the Fixed OWS. All Operator access into the Controls Systems from portable OWS shall be the same Browser format and functionality as provided for the Fixed OWS.

B. Operator Interface
    1. The Operator Interface provided shall include the functionality to selectively combine data and information from any system element or component in the Controls Systems Application on a single Browser window display panel at the Operator's option. This shall include both current information and historical data stored on the Server(s).
    2. The Controls Systems Application OWS shall operate on Microsoft® Windows 2000 or other approved platform.
    3. Each Controls Systems Application fixed and portable OWS shall be on-line configurable for specific functionalities and associated groups of system points and elements.
    4. Navigation Trees:
        a. Provide the capability to display multiple navigation trees that aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the Controls Systems networks.

b. Provide the capability for the Operator to add custom trees. The Operator shall be able to define any logical grouping of systems or points and arrange them on the tree in any selected order. Provide the capability to nest groups within other groups. Provide at minimum for 5 levels of nesting.

c. The navigation trees shall be “dockable” to other displays in the Operator interface including graphic displays. The trees shall appear as part of the display and may be individually detached and minimized to the Windows task bar or closed. Provide for a single keystroke to reattach the navigation tree to a primary display.

5. Divisible Display Windows:

a. Provide for the operator to divide the display area within a single Browser window into multiple display panels. The content of each display panel can be any of the standard summaries and graphics provided in the Controls Systems Application.

b. Provide each display panel with minimize, maximize and close icons.

6. Alarms:

a. Alarms shall be routed directly from primary Controls Systems Application Nodes to OWS and Server(s). Provide for specific alarms from specific points to be routed to selectable OWS and Server(s). The alarm management portion of the Controls Systems software shall, at minimum, provide the following functions:

1) Log date and time of alarm occurrence.

2) Generate a “Pop-Up” window on the Browser display panel, with audible alarm, informing the Operator that an alarm has been received.

3) Allow an Operator, with the appropriate password, to acknowledge, temporarily silence or cancel an alarm.

4) Provide an audit trail on hard drive for alarms by recording user acknowledgement, deletion or canceling of an alarm. The audit trail shall include the ID 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 alpha-numeric pager. This must be provided in addition to the pop-up window described herein. Controls Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.

6) Provide for any attribute of any object in the Controls Systems to be designated to report as an alarm.

b. The Controls Systems Application shall annunciate systems diagnostic alarms indicating system failures and non-normal operating conditions.

c. The Controls Systems Application shall annunciate controls alarms at minimum as required by Part 3.

d. Provide the on-line means to display alarms within the Browser windows by date/time of occurrence, priority class, point designation, value or other defined text keywords.

7. Reports:

a. Reports shall be generated and directed to one or more of the following: User interface displays, printers archived at the Owner’s de

fined option. As a minimum, the Controls Systems Application shall provide the following reports:

1) All points in the Controls Systems Application.
2) All points in a specific Controls Systems AN.
3) All points in a user-defined group of points.
4) All points currently in alarm.
5) All points locked out.
6) All Controls Systems Application schedules.
7) All user defined and adjustable variables, schedules, interlocks, diagnostics, systems status reports and the like.

b. Provide all applicable original manufacturers standard reports for the Controls Systems.
c. Provide any custom reports as specified in Part 3.

8. Dynamic Color Graphics:
   a. Provide for any number of real-time color graphic displays shall be able to be generated and displayed in the Controls Systems Application limited only by memory data storage capacity.
   b. Graphics shall be based on Scalar Vector Graphic (SVG) technology.
   c. Values of real-time attributes displayed on the graphics shall be dynamic and updated on the displays.
   d. The graphic displays shall be able to display and provide animation based on real-time data that is acquired, derived or entered into the operating Controls Systems.
   e. Provide for the Owner to be able to change values (setpoints) and states in system controlled equipment directly from the graphic display.
   f. Provide a graphic editing tool that allows for the creation and editing of graphic files. It shall be possible to edit the graphics directly while they are on line, or at an off line location for later downloading to the AN.
   g. Provide a complete user expandable symbol library containing all of the basic symbols used to represent components of a typical system. Implementing these symbols in a graphic shall involve dragging and dropping them from the library to the graphic.
9. Schedules:
   a. Provide multiple schedule input forms for automatic time-of-day scheduling and override scheduling of operations. At a minimum, the following spreadsheet types shall be accommodated:
      1) Weekly schedules.
      2) Temporary override schedules.
      3) Special “Only Active If Today Is A Holiday” schedules.
      4) Monthly schedules.
   b. Schedules shall be provided for each group, system and sub-system in the Controls Systems Application. It shall be possible to include all or any commandable points residing within the Controls Systems in any custom schedule. Each point shall have a unique schedule of operation relative to the system use schedule, allowing for sequential starting and control of equipment within the system. Scheduling and rescheduling of points shall be accomplished easily via the system schedule spreadsheets.
   c. Multiple monthly calendars for a 12-month period shall be provided that allow for simplified scheduling of holidays and special days 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 weekly schedules.

10. Operator Access Security (Combined Password and User ID):
    a. Provide for Operator access into the Controls Systems via the use of on-line Owner defined software Password and User Identification (ID) pairs, unique for each Operator and unique throughout the Controls Systems Application, to supplement standard password access control.
    b. Stored password/user ID definitions shall be stored in encrypted formats whether at the Controls Server or at the AN.
    c. Password logins shall not be echoed on any screen or printer except during Master Password definition processes. An Operator defining a password shall be required to re-enter to confirm authenticity.
    d. Operator access privileges shall be definable in terms of functions and Project areas.
    e. As part of the access privileges definition for each user the Owner shall be able to define at minimum the following:
        1) Access times by day.
        2) Permanent or temporary, with expiry date, password.3) Number of incorrect access attempts allowed before the password is disabled.
        4) Whether or not the Operator is able to redefine their own password.
        5) A field for the Operator's e-mail address.
        6) A field for the Operator's contact phone number.
        7) Definition of the Operator's access privilege functionalities including viewing only, full control, selected functions, etc.

C. Controls Application Nodes (AN):
    1. Controls AN shall provide both standalone and networked direct digital control of mechanical and electrical building systems as required by the Specifications. The primary AN shall support a minimum of 5,000 field points together with all associated features, sequences, schedules, applications as required for fully functional distributed processing operations.
    2. A dedicated AN shall be configured and provided for each primary HVAC system (air handler, chiller, boiler, etc.) and each Terminal HVAC system (VAV box, Unit Heater, Fan Coil Unit, Cabinet Heater, Heat Pump, Fan Powered Box, CV Box, etc.).
    3. Each AN shall retain program, control algorithms, and setpoint information for at least 72 hours in the event of a power failure and shall return to normal operation upon stable restoration of normal line power.
    4. Each AN shall monitor and report its communication status to the Controls Systems Application. The Controls Systems shall provide a system advisory upon communication failure and restoration.
    5. As indicated in Part 3 or in the drawings, for each primary HVAC system, provide means of indication of monitored and controlled equipment performance and setpoints at or adjacent to the AN.
    6. For each primary HVAC system, provide a means to adjust setpoints and start/stop equipment at or adjacent to the AN.
    7. Provide a means to prevent unauthorized personnel from accessing setpoint adjustments and equipment control definitions at the AN.

8. The AN shall provide the functionality to download and upload configuration data, both locally at the AN and via the Controls Application networks.
9. The AN shall perform the functional monitoring of all Controls Application variables, both from real hardware points, software variables, and controller parameters such as setpoints.
10. The primary AN shall manage and direct all information traffic on the Tier 1 network, between the Tier 1 and Tier 2 networks and to the Server(s).
11. All AN on the Tier 1 network shall be equipped with all software and functionality necessary to operate the complete user interface, including graphics, via a Browser connected to the Node on the network or directly via a local port on the AN.
12. The AN shall be capable of direct connection to multiple field busses using different protocols simultaneously as indicated below. Should the AN not support multiple field busses, then install multiple AN in parallel to achieve this functionality. An RS-485 serial field bus such as MSTP or the manufacturer's proprietary field bus.
13. The AN shall integrate data from both field busses into a common and conformal object structure. Data from both field busses shall appear in common displays throughout the Operator Interface in the same format. Conformal formatting shall be provided for each type of data not dependent on the type of field bus from which the data originated.
14. The AN shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions. They shall be proven standard product of their original manufacturer and not a custom product for this Project.
15. A failure at an AN shall not cause failures or non-normal operation at any other system AN other than the possible loss of active real-time information from the failed AN.
16. Ancillary AN equipment, including interfaces and power supplies, shall not be operated at more than 80% of their rated service capacity.
17. Each AN shall retain program, control algorithms, and setpoint information in non-volatile memory in the event of a power failure, and shall return to normal operation upon restoration of power.
18. Each An shall report its communication status to the Application. The Application shall provide a system advisory upon communication failure and restoration.
19. The AN shall incorporate the ability to download and upload configuration data, both locally at the AN and via the Application communications network.
20. The AN shall be provided with a permanently-mounted local graphic terminal where required in the definitions of Part 3 of this Specification. The local graphic terminal shall provide dynamic graphical representation of the associated system status, with the ability for the Operator to enter commands with proper password protection.
21. Each primary Controls Systems AN shall be provided with the necessary un-interruptible power facilities to ensure its continued normal operation during periods of line power outages of, at minimum, 1 minute duration. This normal functionality shall include all normal software processing, communication with powered field devices and network communications with other powered Controls Systems AN, Servers and OWS.

2.5 WIRING:

A. The multi-conductor cable for field wiring of electronic analog sensors shall be minimum No. 22 AWG, 300 volt, thermoplastic with stranded copper wire and 100% shield coverage. The number of conductors in each sensor cable shall be as determined by the Contractor. 2/c #22 shielded cables shall be Belden Catalog #8451 3/c #20 shielded cables shall be Belden Catalog #9770.

B. Conductors for digital sensors or contact control shall be the same as for the analog sensors, except the grounded shield is not required.

C. Individual conductors shall be color-coded and in addition shall be numbered in the field to identify the particular terminal to which attached. Field numbering shall be performed with Brady markers wrapped around the wire near the terminal connection. All wires shall be terminated with pressure type connectors suitable for wire size, material and terminal connection.

D. All wiring shall be installed in a designated conduit raceway, unless otherwise specified. The conduit shall conform to Section 16100 of the specification.

E. All junction boxes shall have covers painted "safety green", and be rigid steel.

2.6 CONTROLLERS:

A. Thermostats shall be electric, two position type.

B. All temperature sensors, humidity sensors, CO_2 sensors, etc. shall be provided with cast iron or stainless steel vandal proof covers and shall be locking type, key to open with blank metallic cover. Thermostats and/or temperature sensors used in air conditioning areas shall have two set points. All room thermostats and temperature sensors shall be mounted 48" (centerline) above the furnished floor, except in stairways, corridors and toilets, Multipurpose Spaces, which shall be 7'-0". For these areas, provide concealed/recessed mounted (i.e., flush-mounted) thermostats/temperature sensors, and/or transmitter with stainless steel faceplate. Provide insulating bases where thermostats and/or temperature sensors are located on exterior or unconditioned walls. Each thermostat shall have adjustable limit stops and adjustable sensitivity. Provide mounting bracket for all thermostats and temperature sensors.

C. Low Limit Thermostats:
   1. Freezestats shall have a minimum 20 foot (averaging sensing element) capillary tube sized to the basis of one linear foot of capillary tube for each square foot of coil surface. Thermostat sensitivity shall be adjustable from 1/4 PSI to 2 PSI per degree Fahrenheit. Freezestats shall stop supply and return fans and close the outside air damper if mixed air temperature drops below 35ºF. Freezestat shall be automatic reset except for RTU's/ERU's which shall be manual reset type..
   2. Pneumatic low limit thermostat controllers shall be provided for air handling units and unit ventilators to maintain a minimum air temperature. Low limit stat shall be proportional direct acting, 0ºF to 270ºF operating range, adjustable sensitivity range from .25 to .75 PSI per degree Fahrenheit, 0ºF to 270ºF set point range, die cast aluminum body, ABS plastic cover and 8 ft. copper averaging element with holder. Low limit thermostat shall be by Siemens Controls sole source.

D. Relays and switches shall be provided as necessary to accomplish the sequence of control specified herein. Relays shall be die cast metal selected for the required application.

2.8 CONTROL PANELS:

A. Furnish and install local panels for indicating controllers, switches, relays, etc. Control panels shall be fully enclosed cabinets, all steel construction and shall meet the requirements of NEMA 1 (indoors) or NEMA 3RX (outdoors) enclosures and be UL 50 Listed meeting UL864 Standards. Cabinet shall have piano hinged door with a locking latch. All cabinet locks shall use common key. Provide means of storing control system instructions and drawings inside cabinet for future reference. Panel shall be wall mounted or free standing and located where directed by the Architect. All gauges and switches in the face of panels shall be identified with micarta nameplates with etched white filled letters not less than 1/2" high.

2.9 MISCELLANEOUS ELECTRICAL DEVICES:

A. Firestats shall be 135ºF manual reset, line voltage type with bi-metal actuated switches. Switch shall have an adequate rating for the applied load.

B. Safety low limit shall be manual reset line voltage type with bellows actuated switches. Twenty foot capillary shall be responsive to the coolest section of its length.

C. Electric thermostats shall be line voltage or low voltage type suitable for the application. Low voltage type shall have heat anticipation. Ratings shall be adequate for the applied load.

D. Aquastats shall be line voltage strap on type with single pole, single throw switching. Switches shall have an adequate rating for the applied load.

2.10 MONITORING SYSTEM, SENSORS AND WIRING:

A. Sensors and other Devices for Input/Output Summary Schedule:

1. Provide all necessary sensors, relays, panels, data terminal cabinets, conduits and wire for the points indicated in the input/output summary as shown on the Contract Drawings for tie-in to existing Energy Management System.

2. Analog sensing elements for remote indication shall be independent of local pneumatic sensors used for local control loops.

3. Temperature sensors shall be Resistance Temperature Detector (RTD) Copper wound or Balco wire wound types of 1000 ohm at 70ºF or thermistor resistance sensor, maximum 10,000 ohms at 70ºF; accurate to ±0.5F over their maximum operating temperature limits. Space (60-90°F); Duct/Well (-30-250°F); Averaging Duct (-30-225°F) or as required. Sensing elements shall be of a configuration such as to accurately sense temperature of the medium (air or water) over the full range of the piping, duct, casing or equipment. All temperature sensors in piping shall be installed in wells with conductive gel.
   a. Space temperature sensors shall be provided with override push button and equipped with RJ-II (or similar) plug in jacks for communication via a portable operators tool with setpoint adjustable software limited to ±2ºF above/below the programmed heating/cooling setpoints. Sensors shall not be provided with thermometer or temperature displays.
   b. Duct temperature sensors shall be rigid stem or averaging type as specified in the sequence of operation. Water sensors shall be provided with a separable copper, monel or stainless steel well. Outside air wall mounted sensors shall be provided with a sun shield.

4. Differential and Static Pressure Sensors and Switches

a. Fan proof-of-flow switches shall be UL Listed adjustable set point and differential pressure type. Switches shall be piped to fan discharge except where fans operate at less than one inch WG, they shall be piped across the fan. For fractional horsepower and non-ducted fans, relays or auxiliary contacts may be used. Maximum pressure rating shall be at least 10 inches WG. with .05-12" W.C. range.
b. Pump proof-of-flow switches shall be UL Listed adjustable differential pressure or flow type as specified in the sequence of operation or data point summary. Devices shall be 150 psi rated except chilled water flow switches shall be provided with totally sealed vapor tight switch enclosure on 300 psi body. Differential pressure switches shall have valved manifold for servicing, and a range of 3 psi-150 psi.
c. Air flow and static pressure analog sensors shall be high accuracy suitable for the low velocity pressures to be encountered, be selected for approximately 50% overrange, and have a 4 to 20 mA output. These differential pressure sensors shall be connected to the air flow measuring station with valved lines for testing and calibration, and shall have adjustments for zero and span. 5" W.C. range.
d. Water flow analog sensors shall be provided complete with flow element and shall be an all solid state precision industrial type with stainless steel meter body, maximum error of no more than .5% or span, and 4 to 20 mA output. Sensor shall be rated for 250 psi minimum and installed in strict accordance to the manufacturer's instructions complete with three-valve manifold for calibration and maintenance. Hydronic differential pressure sensor shall be resettable through the ATC System. Manufacturer shall be Rosemount Model DP-2051, intelligent type.

5. Overall system accuracy, including electronic analog sensing elements, shall be as follows:

a. Air: Plus or minus 1.0°F temperature, plus or minus 2.5% r.h., plus or minus 2.0% static pressure.
b. Water: Plus or minus 0.7°F over full scale range for chilled water points, plus or minus 1.0ºF. for others.
c. BTU Calculations: Plus or minus .3°F for chilled water input points.
d. Proof of fan or pumps operating status, or alarm conditions shall be through positive feedback from differential pressure switches across fan or pump. Auxiliary dry contacts may be used for proof of fans or pumps if the motors are fractional H.P., and other non-ducted fans.

6. Digital inputs from devices with isolated, dry type contacts (no grounds, no voltage) of either normally open (N.O.) or normally closed (N.C.) configuration shall be provided. Live contact inputs, those that have voltage present, shall be provided with isolating devices to meet dry contact requirements.

7. Liquid flow data shall be received and transmitted by industrial grade instrument similar in quality to Rosemount type differential pressure transmitter. Pulse type data sensors shall not be acceptable.

8. Start-stop relay module shall contain relays for start-stop function at the remote point, with relays mounted and factory wired to numbered terminal strips.

9. Outage Devices:

a. Control Relays: Control relay contacts shall be rated for the application, with a minimum of two sets of Form C contacts, enclosed in a dustproof

enclosure. Relays shall have silver-cadmium contacts with a minimum life span rating of one million operations. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression limiting transients to nondamaging levels.

b. Time Delay Relays: Time delay relay contacts shall be rated for the application with a minimum of two sets of Form C contacts enclosed in a dustproof enclosure. Relays shall have silver-cadmium contacts with a minimum life span rating of one million operations. Relays shall be equipped with coil transient suppression devices to limit transients to nondamaging levels. Delays contact opening or closing shall be adjustable from one to 60 seconds with a minimum accuracy of plus or minus 2 percent of setting.

c. Latching Relays: Latching relay contacts shall be rated for the application with a minimum of two sets of Form C contacts enclosed in a dustproof enclosure. Relays shall have silver-cadmium contacts with a minimum life span rating of one million operations. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to nondamaging levels.

d. Reed Relays: Reed relays shall be encapsulated in a glass-type container housed in a plastic or epoxy case. Contacts shall be rated for the application. Operating and release times shall be one millisecond or less. Reed relays shall have a minimum life span rating of 10 million operations.

e. Contactors: Contactors shall be of the single-coil, electrically operated, mechanically held type. Positive locking shall be obtained without the use of hooks, latches, or semi-permanent magnets. Contacts shall be double-break silver-to-silver type protected by arcing contacts. Number of contacts and ratings shall be selected for the application. Operating and release times shall be 100 milliseconds or less. Contactors shall be equipped with coil transient suppression devices to limit transients to nondamaging levels.

f. Solid-State Relays: Input-output isolation shall be greater than 1000 megohms with a breakdown voltage of 1500 V rms or greater at 60 Hz. The contact life shall be 10 million operations or greater. The ambient temperature range shall be minus 20 degrees to plus 140°F. Input impedance shall not be less than 500 ohms. Relays shall be rated for the application. Operating and release times shall be one millisecond or less. Transient suppression shall be provided as an integral part of the relay to limit transients to nondamaging levels.

g. Remote Control Setpoint Adjustment (RCPA) Controller: RCPA controllers shall have a setpoint adjustment of plus or minus 10 percent of the primary sensor input span. The operating span of the CPA controller authority-submaster effect of secondary transmitter on set point shall be adjustable from 33 to 200 percent of primary sensor range. The controller shall have built-in or external means of checking input and output signals for calibration.

10. Audible Alarm: An audible alarm with reset button and indicating lamp shall be provided for each system indicated on the point list to have an alarm condition.

2.11 LOCAL CONTROL PANELS

A. Provide control panels with suitable brackets for either wall or floor mounting, for each control system.

1. Fabricate panel of 14 gauge furniture-quality steel, or 6063-T5 extruded aluminum alloy, totally enclosed, with hinged doors and keyed lock, with manufacturer's standard shop-painted finish and color. Provide UL-Listed cabinets for use with line voltage devices.
2. Panel-Mounted Equipment: Include temperature and humidity controllers, relays and automatic switches, except exclude low-temperature protection thermostats, firestats, and other devices excluded in sequence of operation. Fasten devices with adjustments accessible through front of panels.
3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper "minimum-off" positioning switches, "summer-winter" switches, and "manual-automatic" switches; and including dial thermometers.

2.12 CENTRAL (MASTER) CONTROL PANELS

A. Provide central control panels of fully-enclosed steel cubical type, with locking doors and/or locking removable backs. Match finish of panels and provide multi-color graphic displays, schematically showing system being controlled.

2.13 SOFTWARE

A. Space temperature setpoints shall be specified to be 70ºF heating / 76ºF cooling per CCPS standards. Space temperature sensors provided with setpoint adjusters shall have adjustments software limited to ±2ºF.

B. Scheduling: Operating schedules shall be adjustable via a graphic utility. Scheduling feature shall include multiple seven-day master and regular schedules, plus holiday, special, and “snow day” schedules. A yearly calendar feature shall allow assignment of holidays and automatic reset of system real time clocks for transitions bet between daylight savings time and standard time. Schedules shall reside in building controllers, not on the system server. Each type of schedule shall have start time and stop time. Normal conventions shall be that “stop”, “unoccupied”, or “off” shall place the controlled building/zone/equipment in the unoccupied mode; “start”, “occupied”, or “on” shall place the controlled building/zone/equipment in the occupied mode. Default of the schedule shall be “off” (stop, unocc); operator entries shall be required to schedule equipment “on” (start, occ). Equipment shall be assigned to Zone schedules. Each and all zones shall be controllable by any of the five types of schedules in any combination and the schedules shall operate concurrently. Schedule Types:

1. Master Schedule: Provide a repeatable 7-day master schedule. All zones assigned to the Master Schedule shall respond to the daily on/off entered in that schedule. Each day schedule shall be able to have multiple on/off times. This schedule is construed as that which controls the building on a regular, daily basis.

   Each building shall be provided with a 10-month and 12-month Master schedule.
2. Regular Schedule: Provide repeatable 7-day Regular schedules for each Zone. Each day of the schedule shall function with multiple on/off times. Regular schedules shall be used to provide “on” times in addition to those scheduled in the Master schedule.
3. Holiday Schedule: Holiday schedules shall temporarily modify the Master and Regular schedules. It shall be possible to schedule holidays a year in advance. Holidays shall be entered by date; Master and Regular schedules shall respond to the holiday schedule for the date entered.

4. Special Schedule: Special schedules supersede all other schedules. Special schedules are single event schedules entered by time and date. Single event schedule shall be able to be entered up to one year in advance of the event. A minimum of 12 single event schedules per year per zone shall be provided. (The cessation of the single event schedule shall be inherent once the date and time have passed).
5. "Snow Day" Schedule: Provide a single point command accessible to the Energy Management personnel so that when the "Snow day" command is issued, all assigned schools are placed in their local "snow day" schedules.

PART 3 - EXECUTION

3.1 GENERAL:

A. The Automatic Temperature Control System shall be designed, installed, and commissioned in a turnkey fully implemented and operational manner.

B. The automatic temperature control contractor shall copy the Saint Mary's County Public Schools project manager on all correspondence to the mechanical contractor.

3.2 INSTALLATION:

A. All wiring and tubing shall be properly supported and run in a neat and workmanlike manner. All wiring and tubing exposed and in equipment rooms shall run parallel to or at right angles to the building structure. All piping and wiring within enclosures shall be neatly bundled and anchored to prevent restriction to devices and terminals.

B. The Control Contractor shall be responsible for all electrical installation required for a fully functional control and automation system and not shown on the electrical plans or required by the electrical specifications. All wiring shall be in accordance to all local and national codes.

1. All line voltage wiring, all wiring exposed, and all wiring in equipment rooms shall be installed in conduit in accordance to the electrical specifications.
2. All electric and electronic wiring shall be #18 AWG minimum THHN and shielded if required.
3. All wiring in the central control room shall be concealed in an approved manner.

C. Controls Systems Wiring:

1. All conduit raceways, wiring, accessories and wiring connections required for the installation of the Controls Systems shall be provided by the Controls Contractor except as shown on the Electrical Trade documents. All wiring shall comply with the requirements of applicable portions of the Electrical Trade work and all local and national electric codes and the requirements of the AHJ.
2. All Controls Systems wiring materials and installation methods shall comply with the original equipment manufacturer recommendations and standards.
3. The sizing type and provision of cable, conduit, cable trays and raceways shall be the design responsibility of the Controls Contractor.
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 5ft.

from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines.

5. Class 2 signal wiring and 24VAC power may be run in the same conduit. Power wiring 120VAC and greater shall not share the same conduit with Class 2 signal wiring.
6. Perform circuit tests using qualified personnel only. Provide necessary instruments and equipment to demonstrate that:

    a. All circuits are continuous and free from short circuits and grounds.
    b. All circuits are free from unspecified grounds; that resistance to ground of all circuits is no less than 50 megaohms.
    c. All circuits are free from induced voltages.

7. Provide complete testing for all cables and wiring. Provide all equipment, tools, and personnel as necessary to conduct these tests.
8. Provide for complete grounding of all signal and communication cables, panels and equipment so as to ensure integrity of Controls Systems operation. Ground cabling and conduit at panel terminations. Do not create ground loops.

D. Line Voltage Power Sources

1. 120-volt AC circuits for the Controls Systems shall be taken by the Controls Contractor from electrical trade panelboards and circuit breakers as designated on the electrical drawings.
2. Circuits used for the Controls Systems shall be dedicated to these Controls Systems and shall not be used for any other services.
3. Controls DDC terminal unit controllers may use 120-volt AC power from motor power circuits.

E. Controls Systems Raceways

1. All wiring shall be installed in conduit or raceway except as noted elsewhere in the Specification. Minimum conduit size 3/4”.
2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the supporting surface.
4. UL/ULC Listed 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 and for final connection to equipment.

F. Penetrations

1. Firestopping for all penetrations used by dedicated Controls Systems conduits and raceways shall be by the ATC Contractor.
2. All openings in fire proofed or fire stopped components shall be closed by the ATC Contractor using approved fire resistive sealant.
3. All wiring passing through penetrations, including walls, shall be in sleeves, conduit or enclosed raceway.

4. No penetrations through building structural elements, slabs, ceilings and walls shall be made before receipt of written approval from the Architect.

G. Controls Systems Identification Standards

1. Node Identification: All nodes shall be identified by a permanent label fastened to the outside of the enclosure. Labels shall be suitable for the node environmental location.
2. Cable shall be labeled at every termination with cross-referencing to record documentation.
3. Raceway Identification: Exposed covers to junction and pull boxes of the FMS raceways shall be identified at primary points.
4. Wire Identification: All low and line voltage wiring shall be identified by a number, as referenced to the associated shop and record drawing, at each termination.
5. Wires and cabling shall not be spliced between terminations. Cable shields shall be single end grounded – typically at the panel end outside the panel.
6. Suggested color coding, for use at the Contractors option, are:
    a. Analog Input Cable Yellow
    b. Analog Output Cable Tan
    c. Binary Input Cable Orange
    d. Binary Output Cable Violet
    e. 24 VAC Cable Gray
    f. General Purpose Cable Natural
    g. Tier 1 Comm Cable Purple
    h. Other Tier Comm Cable Blue

H. Field Panel and Device Installations and Locations:

1. The Controls Systems panels, wall boxes, enclosures and cabinets shall be located as coordinated with the Architect at an elevation of not less than 4 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations. Paint inside of box purple.
2. All field devices shall be installed per the manufacturer recommendation and in accessible locations as coordinated with the Architect.
3. Panels to be located in damp areas or areas subject to condensation shall be mounted with wall standoffs.
4. Conduit configurations entering or leaving panels and devices shall be such as to preclude condensation traps.

I. Controls Specific Installation Requirements

1. The Mechanical Trade Contractor shall install all in-line mechanical devices including temperature wells, pressure taps, duct smoke detectors, airflow stations, etc.
2. Controls DDC terminal unit controllers may use 120-volt AC power from motor power circuits.
3. The Mechanical Contractor shall install all in-line devices including control valves, dampers, etc.
4. Input flow measuring devices shall be installed in compliance with ASME Guidelines.

5. Outside Air Sensors:

   a. Sensors shall be mounted on a wall selected to minimize solar radiant heat impact or be located in a continuous intake flow adequate to monitor outside air conditions accurately.
   b. Sensors shall be installed with a rain shield and perforated cover.

6. Water Differential Pressure Sensors:

   a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
   b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
   c. The transmitters shall be installed in an accessible location wherever possible.

7. Medium to High Differential Water Pressure Applications (Over 21” wg):

   a. Air bleed units, bypass valves and compression fittings shall be provided.

8. Differential Air Pressure Applications (-1” to +1” wg):

   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.

9. Air Flow Measuring Station:

   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.

10. 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.

11. Low Temperature Limit Switches:

    a. Install on the discharge side of the first water or steam coil in the air stream.
    b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.

c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.

12. Air Differential Pressure Status Switches: Install with static pressure tips, tubing, fittings and air filter.

13. Water Differential Pressure Status Switches: Install with shut off valves for isolation.

14. 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.

15. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.

16. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.

17. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Controls Systems is to be connected to an external control system as an input (such as chiller control panel), or it 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 building systems. Provide optical isolation between building systems.

3.3 LOCAL CONTROL AND EMS CONTROL:

A. For all central plant systems and as required in the I/O Summary as indicated on the drawings, provide a panel-mounted Hand-Off-Automatic Switch, "Local Control"-"EMS Control"-"Off" switch that allows for the EMS or local controls to start/stop systems and/or equipment.

B. Each system shall operate automatically as described in the sequence of operations when locally controlled; i.e., in the hand position and/or when loss of communications of the remote EMS occurs.

C. Refer to Drawings for additional information.

3.4 SEQUENCE OF CONTROL:

A. Refer to Drawings for Sequence of Operation and I/O Summary Requirements.

3.5 ADJUSTING AND CLEANING:

A. Start-up: Start-up, test, and adjust electric control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

C. Final Adjustment: After completion of installation, adjust thermostats, control valves, motors and similar equipment provided as work of this section. Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of primary temperature control system.

3.6 DATA CONTROL:

A. The following P & ID's show the hardware devices required to be connected to the remote electronic panels, and the standard control software modules to be implemented. In addition, all additional software required to accomplish the detailed sequence of operations specified within this section shall be provided. The following pages also include pseudo points required to be provided for display in logical groups and graphics. Commandable pseudo points shall be commandable directly from all displays.

B. Each analog point shall have unique remote panel resident dual high and dual low limit alarm thresholds as specified elsewhere set in engineering units. Where specified, floating (a band above and below a set point) alarm limits shall be provided.

C. Each digital output shall have a software-associated monitored input. Any time the monitored input does not track its associated command output within a programmable time interval, a "command failed" alarm shall be reported.

D. Where calculated points (such as CFM) are shown, they shall appear in their respective logical groups. The respective unconditioned raw data (such as the logarithmic differential pressure) points shall also be grouped in a special group for display and observation independent of the logical groups.

E. Where data or control points are required to accomplish the digital control or energy management sequences specified but not listed in the summary, the Contractor shall notify the Architect in writing at least fourteen days prior to bid opening. If this timely notification is not received by the Architect, all points required by the sequences shall be provided.

F. Unless otherwise specified or approved prior to bidding, the primary analog input and the analog output of each DDC loop shall be resident in a single remote panel containing the DDC algorithm, and shall function independently of any peer or mux communication links. Secondary (reset type) analog inputs may be received from the peer network, but approved default values and/or procedures shall be substituted in the DDC algorithm for this secondary input if network communications fail or if the secondary input becomes erroneous or invalid.

3.7 CLOSEOUT PROCEDURES:

A. Owner's Instructions: Provide services of manufacturer's technical representative to completely instruct Owner in all aspects of system maintenance and operation; or a minimum of five (5) 8-hour days to instruct Owner's personnel in operation and maintenance of electric control system. The ATC Contractor shall submit a functional test check list including all points and sequence of operation points to be reviewed and verified during the Owner Instruction Period. All sequences shall be tested for all air handling systems, heating plant and cooing plant systems, and 20% of all terminal units for each air handling unit zone. The check list shall include columns for “satisfactory”, “unsatisfactory” and “comments” for each line item. The check list shall be submitted and reviewed as a shop drawing prior to the instructional period. The Contractor shall include all the check lists in a 3-ring binder (10 copies/sets minimum) for the representatives for the instructional procedure.

B. Schedule instruction with Owner. Provide at least a 7-day notice to the Contractor and Engineer of training date. All Operation and Maintenance Manuals shall be provided to Owner three (3) weeks prior to training. Contractor shall be responsible for all operation and maintenance until Owner has had training.

3.8 VERIFICATION

A. Fully test and verify all aspects of the Controls Systems Contract work on a point/system/integrated operational basis for all points, features and functions specified.

B. Acceptance Check Sheet

1. Prepare a check sheet that includes all points and functions of the Work.
2. Submit the check sheet to the Architect for approval 60 days prior to testing.
3. Complete the check sheets for all items and functions of the Work. Initial each entry with time/date as record of having fully calibrated and tested the Work. Submit to the Architect as record.
4. The Architect will use the check sheets as the basis for Acceptance Testing with the Controls Systems Contractor.

C. Provide all necessary specialist labor, materials and tools to demonstrate to the Architect that the Controls Systems have been verified and are operating in compliance with the Controls Systems Contract. Prepare a list of noted deficiencies signed by both the Architect and the Controls Contractor.

D. Promptly rectify all listed deficiencies and submit in writing to the Architect a signed report that this has been done.

E. The Architect will retest the deficiencies in conjunction with the Controls Contractor at the Architect's option.

F. EMS Contractor shall be present and participate in the start-up of the heating plant. Control sequences of operations and coordination of interlocks with equipment manufacturers' controls/safeties shall be demonstrated to the satisfaction and acceptance of Cecil County Public Schools, and the design team.

G. Prior to final acceptance and authorization for final payment by the Owner, Control System inspections shall be made by the EMS Engineer, Mechanical Design Engineer, and representatives of the Owner's construction, maintenance, and energy management departments. The inspections shall be in four parts. An inspection shall be performed regarding the physical installation of the EMS equipment, wiring, etc., a separate inspection regarding head-end (graphics) software programming; and on-site software programming and controls system performance verification shall be performed in both cooling and heating seasons. Any deficiencies discerned during one inspection shall be corrected prior to performing the subsequent inspection.

H. On-site performance verification shall be preceded by trends submissions by the contractor with review and comment by the EMS consultant. Trending shall be presented at hourly intervals for a 24 hour period, unless directed otherwise. Systems being monitored shall be operated with an occupancy schedule; i.e. indications that a system was scheduled off for the 24 hours of the history and remained off are of no value. Occupancy schedule and all system setpoints (both calculated and manual inputs) shall be provided with the histories. To assure that trends suitably demonstrate appropriate operations, heating trends shall be run when outdoor air drops to an occurrence of at least 35°F during the trend period, cooling season trends can be run whenever outdoor air rises to an occurrence of at least 85°F during the trend period.

3.9 PROJECT SPECIFIC REQUIREMENTS:

A. Controls Application

1. Provide a color graphic system flow diagram display for each HVAC system with all points as indicated on the point list. Provide Historical Data Viewer functionality.
2. Provide a text sequence of operation for each system launched from the graphic.
3. Provide a color graphic display for each floor in the facility. Indicate each HVAC zone, color coded to indicate zone values and status.
4. Provide FMS configuration diagrams and bill-of-material for all provided equipment on-line and able to be launched from the OWS.

3.10 SEQUENCES

A. Building Control Application Sequences: Refer to Drawings for Sequences of Operation.

END OF SECTION

SECTION 233113 - METAL DUCTS

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. Single-wall rectangular ducts and fittings. Rectangular double wall ducts and fittings.
2. Single-wall round and flat oval ducts and fittings.
3. Double-wall round and flat oval ducts and fittings.
4. Sheet metal materials.
5. Duct liner.
6. Sealants and gaskets.
7. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in the latest ASHRAE 62 Standard.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculation, for selecting hangers and supports.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Perimeter moldings.

E. Welding certificates.

F. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports; AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports; AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," 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. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," 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."

D. 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 2, "Fittings and Other Construction," 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."

E. All kitchen hood, range hood exhaust ducts shall be 18 gauge minimum, type 304 stainless steel with welded joints and comply with NFPA 96.

F. Minimum duct gauge shall be 22 ga.

2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:

1. McGill AirFlow LLC.
2. Lindab.
3. Semco.
4. Eastern Sheet Metal.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," 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."

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," 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."

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

G. Inner Duct: Minimum 0.028-inch (0.7-mm) perforated galvanized sheet steel having 3/32-inch-(2.4-mm-) diameter perforations, with overall open area of 23 percent, unless otherwise noted to have solid sheet steel.

H. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Traverse (Girth) Joints," 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."

I. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," 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."

J. Provide 20 gauge minimum duct construction for the first fifteen (15) feet supply and twenty (20) feet return/relief ducts connected to blower coil units and energy ventilator units and associated return air fans unless noted otherwise. This ductwork shall be internally lined provided perforated inner galvanized liner covering.

K. Minimum duct gauge shall be 22 ga.

2.3 SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Lindab Inc.
    b. McGill AirFlow LLC.
    c. SEMCO Incorporated.
    d. Eastern Sheet Metal.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," 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."

1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," 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."

1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," 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."

F. All round ductwork shall be spiral type, 22 ga. minimum.

G. All fittings shall be fully welded type. Only use fittings as detailed on the Drawings. Straight tees and laterals are prohibited. Ninety-degree mitered elbows, bull head tees, and saddle taps are prohibited.

H. Exposed ductwork shall be paint grade.

2.4 DOUBLE-WALL ROUND DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.
4. Eastern Sheet Metal.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," 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."

    a. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," 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."

    a. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
    b. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," 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."

D. Inner Duct: Minimum 0.028-inch (0.7-mm) perforated galvanized sheet steel.

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

F. All round ductwork shall be spiral type, 22 ga minimum.

G. All fittings shall be fully welded type. Only use fittings as detailed on the Drawings. Straight tees and laterals are prohibited. Ninety-degree mitered elbows, bull head tees, and saddle taps are prohibited.

2.5 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Provide 18 gauge minimum duct construction for the first fifteen (15) feet supply and return ducts connected to roof-mounted air handling units. This ductwork shall be internally lined provided with perforated inner galvanized liner covering and externally insulated with rigid board insulation.

C. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90 (Z275).
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.6 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by Owens Corning or one of the following:

a. CertainTeed Corporation; Insulation Group.
b. Johns Manville.
c. Knauf Insulation.
d. Owens Corning.

2. Maximum Thermal Conductivity:

a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F (0.033 W/m x K) at 75 deg F (24 deg C) mean temperature.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
4. Solvent-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

    a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick aluminum; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).
7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.

9. Secure insulation between solid sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.7 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches (102 mm).
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.

2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.8 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.9 OPEN END DUCTS (OED)

A. Whether indicated on plans or not, all open-ended ducts shall be provided with a protective screen.

B. All open-ended ducts shall be furnished with a heavy gauge aluminum ½”x½” bird screen. Screens shall be permanently installed in a removable frame, and the frame shall be attached to

the open-ended duct in a neat, workmanship-like manner without any exposed edges or sharp surfaces.

C. Screen shall be attached to a 3/4-inch x 1/8-inch continuous galvanized perimeter frame. Install duct stiffeners greater than 16 inches in any direction at open-ended ducts.

D. Terminate open end ducts above occupied area's cut on a 45 angle open to top.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

M. All ductwork shall be shipped and stored with ends and openings sealed. All open ducts shall be sealed at the end of each work day.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system. Round exposed ducts shall utilize joint o-ring seals.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet (6 m) in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches (38 mm) from bottom of duct.

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 DUCT SEALING

A. 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, except for round exposed ducts, which shall utilize joint o-ring seals.

B. 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":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class A.
4. Outdoor, Return-Air Ducts: Seal Class A.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class A.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class A.
8. Unconditioned Space, Return-Air Ducts: Seal Class A.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.

10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class B.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports. Provide cable type hanger for the gym.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

G. Cable hangers are prohibited except for exposed ductwork located in the gym.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have exposed duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

B. All exposed ductwork shall be primed and painted. Utilize paint grade ductwork. Coordinate requirements with the general trades contractor.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

    a. Ducts with a Pressure Class Higher Than 3-Inch wg (750 Pa): Test representative duct sections, totaling no less than 100 percent of total installed duct area for each designated pressure class.
    b. Supply Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections, totaling no less than 100 percent of total installed duct area for each designated pressure class.
    c. Return Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections, totaling no less than 100 percent of total installed duct area for each designated pressure class.
    d. Exhaust Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections, totaling no less than 100 percent of total installed duct area for each designated pressure class.
    e. Outdoor Air Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections, totaling no less than 100 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give five days' advance notice for testing.
7. All duct testing shall be witnessed by the Testing and Balancing Company, and by the Owner’s Representative.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to FCU, blower coil units, and energy recovery units:

a. Pressure Class: Positive 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

C. Return/Relief Ducts:

1. Ducts Connected to FCU’s, blower coil units and energy recovery units:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.
e. Provide 18 gauge and 2” thick double wall ductwork for twenty feet on the inlet and outlet of each indoor in-line centrifugal or mixed flow fan.

2. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

3. Ducts Connected to General Kitchen Exhaust Ductwork (Aluminum).
a. All general kitchen exhaust ducts shall be aluminum.
b. These exhaust systems are low pressure service (-)2”W.G.
c. All elbows are round. Squared elbows of 90 degrees are not permitted.
d. All joints are welded by gas fusion using rods of similar materials.
e. All dampers, manual and motorized, shall be aluminum.
f. These exhaust systems shall be fabricated and installed in strict accordance with requirements of SMACNA and NFPA.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil and Terminal Units:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to DOAS and Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

2. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

3. Aluminum Ducts: Aluminum.

G. Liner:

1. Supply Air Ducts: Fibrous glass, Type I, 1 inch (25 mm) thick with perforated liner unless indicated otherwise.
2. Return Air Ducts: Fibrous glass, Type I, 1 inch (25 mm) thick with perforated liner unless indicated otherwise.

H. Double-Wall Duct Interstitial Insulation:

1. Lined ductwork shall be installed in exposed occupied areas and for the first fifteen (15) feet of supply return and relief air ductwork from blower/fan coil units and energy recovery units indicated otherwise and to the extent shown on the drawings.

2. Round exposed ductwork shall be paintable galvanized steel, double wall construction with perforated interior liner and self-sealing duct connectors, similar to Lindab.

3. Supply and Return Air Ducts: 1 inch (25 mm) thick unless indicated otherwise.

4. All lined ductwork shall have a perforated galvanized inner liner.

5. Line all exterior ductwork.

I. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

   a. Velocity 1000 fpm (5 m/s) or Lower:

      1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      2) Mitered Type RE 4 without vanes.

   b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):

      1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with air foil vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

   c. Velocity 1500 fpm (7.6 m/s) or Higher:

      1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with air foil vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with air foil type vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam.

J. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.
c. Refer to Drawing Details.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are only permitted in existing duct. Provide only fittings detailed on the Drawings. All other fittings are prohibited.

a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree conical tap.
b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Lo Loss fitting or 45-degree conical lateral.
c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree conical lateral (or Lo Loss fitting where indicated on the Drawings).
d. Refer to Drawing Details.

END OF SECTION 23 31 13

SECTION 23 33 00 - AIR DUCT 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. Section Includes:
1. Manual volume dampers.
2. Control dampers.
3. Flange connectors.
4. Turning vanes.
5. Remote damper operators.
6. Duct-mounted access doors.
7. Flexible connectors.
8. Flexible ducts.
9. Duct accessory hardware.

B. Related Sections:

1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control damper installations.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

C. Source quality-control reports.

D. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

1.5 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180).
2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide Ruskin MD-35 (Rectangular), Ruskin MDRS25 (Round), or comparable product by one of the following:

a. Air Balance Inc.; a division of Mestek, Inc.
b. American Warming and Ventilating; a division of Mestek, Inc.

c. METALAIRE, Inc.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications with velocities to 1500 feet per minute and 3 inches w.g.
4. Frames:

   a. Hat-shaped, galvanized-steel channels, 0.064-inch (1.62-mm) minimum thickness.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.
   d. Two-inch insulation stand-off bracket with extended shaft rod.
   e. Hand Quadrant.

5. Blades:

   a. Multiple or single blade with blade stop.
   b. Opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized-steel, 0.064 inch (1.62 mm) thick.
   e. Six-inche nominal width.

6. Blade Axles: Galvanized steel. Hex-shaped, mechanically attached to blade, minimum 1/2” diameter.
7. Bearings:

   a. Oil-impregnated bronze iolite bearings.
   b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide Ruskin MD-35 or comparable product by one of the following:

   a. Air Balance Inc.; a division of Mestek, Inc.
   b. American Warming and Ventilating; a division of Mestek, Inc.
   c. McGill AirFlow LLC.
   d. METALAIRE, Inc.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts. Two-inch insulation stand-off bracket with extended shaft rod and hand quadrant.
5. Blades:

   a. Multiple or single blade with blade stop.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.
   e. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.

6. Blade Axles: Minimum 1/2-inch diameter stainless steel.

7. Bearings:

   a. Oil-impregnated bronze, oillite bearings.
   b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Aluminum.

2.3 CONTROL DAMPERS (LOW LEAK)

A. Manufacturers: Subject to compliance with requirements, provide Ruskin CD60 or products by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. METALAIRE, Inc.
5. Ruskin Company.

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage. Leakage shall be less than 3 cfm/square foot at 1-inch static pressure/less than 8 cfm/square foot at 4 inches of static pressure, and is AMCA-Certified as a Class 1A damper.

C. Frames:

1. 5” x 1” x 16 gauge hat channel shaped reinforced with corner braces.
2. Galvanized -steel channels, 0.064 inch (1.62 mm) thick.
3. Mitered and welded corners.
4. Round, oval and rectangular duct transition connections shall be welded for high pressure.

D. Blades:

1. Multiple blade with maximum blade width of 8 inches by 6 inches high.
2. Parallel (2 position) and Opposed-blade (modulating) design.
3. Galvanized or stainless steel.
4. Double skin, airfoil type 14 gauge equivalent thickness.
5. Blade Edging: Neoprene blade edge seals and flexible metal compressible jamb seals.

E. Blade Axles: 1/2-inch- (13-mm-) hexagonal positively locked into the damper blade; galvanized or stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. Removable control shaft shall extend 6-inches beyond frame.

1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

F. Bearings:

1. Permanently lubricated, corrosion-resistant stainless-steel sleeve.
2. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.4 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gauge and Shape: Match connecting ductwork.

2.5 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Single and Double wall.

E. Vane Construction: Single wall for ducts up to 24 inches wide and double wall for larger dimensions.

2.6 REMOTE DAMPER OPERATORS

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. Pottorff; a division of PCI Industries, Inc.
2. Ventfabrics, Inc.
3. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Wall-Box Mounting: Recessed, 2 inches (50 mm) deep.

F. Wall-Box Cover-Plate Material: Stainless steel.

2.7 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. McGill AirFlow LLC.
5. Nailor Industries Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches.
d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 6-inch wg (2500 Pa).
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.

9. Insulation Fill: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.8 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
2. Minimum Tensile Strength: 500 lbf/inch (88 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor 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 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch (6-mm) movement at start and stop.

2.9 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
4. Insulation R-value: 6.0 at 72 deg F.

C. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

2.10 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.

2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. Control devices requiring inspection.
8. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Minimum Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
5. Body Access: 25 by 14 inches (635 by 355 mm).
6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Do not use flexible ducts to change directions.

O. Connect diffusers and / or diffuser boxes to ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with draw bands plus sheet metal screws.

Q. Install duct test holes where required for testing and balancing purposes.

R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

SECTION 233423 - HVAC POWER VENTILATORS

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. Ceiling-mounting ventilators.
   2. In-line centrifugal fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level.

B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material thickness and finishes, including color charts.
   5. Roof curbs.
   6. Fan speed controllers.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

   1. Wiring Diagrams: Power, signal, and control wiring.
   2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
   3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

   1. Roof framing and support members relative to duct penetrations.

2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.8 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. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 CEILING-MOUNTING VENTILATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Greenheck.
2. Loren Cook Company.
3. Penn Barry.

B. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.

C. Housing: Steel, lined with acoustical insulation.

D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

E. Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.

F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

G. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
3. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
4. Isolation: Rubber-in-shear vibration isolators.
5. Manufacturer's brick vent (as sized on the drawings) and transition fittings.

H. Capacities and Characteristics: Refer to Mechanical Equipment Schedules for capacities.

2.2 IN-LINE CENTRIFUGAL FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Greenheck.
2. Loren Cook Company.
3. Penn Barry.

B. Description: In-line, direct-driven centrifugal fans consisting of insulated housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

C. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

D. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing with whee4l inlet cone and motor on swing out service door.

E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and copper lubricating tubes from fan bearings extended to outside of fan housing.

F. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

G. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent for direct drive fans.
2. Companion Flanges: For inlet and outlet duct connections.
3. Fan Guards: 1/2- by 1-inch (13- by 25-mm) mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

H. Capacities and Characteristics: Refer to Mechanical Equipment Schedules for capacities.

1. Vibration Isolators:

a. Type: Elastomeric hangers.
b. Static Deflection: 1 inch (25 mm).

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices and Wiring: Comply with requirements for electrical devices and connections specified in Division 25 sections.

B. Enclosure Type: Totally enclosed, fan cooled.

C. Provide ECM type where indicated on the drawings.

2.4 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Support units using elastomeric mounts and spring isolators having a static deflection of 1 inch (25 mm). Vibration- and seismic-control devices are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

1. Secure vibration controls to concrete bases using anchor bolts cast in concrete base.

C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 23.

D. Secure roof-mounting fans to roof curbs with stainless steel hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

E. Ceiling Units: Suspend units from structure; use steel rod or metal straps with vibration isolators.

F. Support suspended units from structure using threaded steel rods and elastomeric hangers and spring hangers having a static deflection of 1 inch (25 mm). Vibration-control devices are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

G. Install units with clearances for service and maintenance.

H. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Verify lubrication for bearings and other moving parts.

7. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
8. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
9. Shut unit down and reconnect automatic temperature-control operators.
10. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust belt tension.

B. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

C. Replace fan and motor pulleys as required to achieve design airflow.

D. Lubricate bearings.

END OF SECTION 23 34 23

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

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. Louver face diffusers.
2. Heavy Duty Register.
3. Ceiling and Sidewall Return and Exhaust Grilles.
4. Adjustable Bar Supply Registers – Standard.

B. Related Sections:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
3. Diffusers, registers, and grilles shall be tested in accordance with ANSI/ASHRAE 70-1991.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

E. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Square and Rectangular Louver Face Diffuser:
1. Basis-of-Design Product: The manufacturer shall provide published performance data for the diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991. Subject to compliance with requirements, provide Titus Model TDC, as indicated on the drawings or comparable product by one of the following:
   a. Krueger.
   b. METALAIRE, Inc.
   c. Price Industries.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Construction shall be of steel except for the Kitchen, locker rooms, shower rooms, and science labs/prep rooms which shall be aluminum.
4. Finish: The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315 deg F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM D117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250 hour ASTM 0870 Water Immersion Test. The paint must also pass the ASTM D-2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
5. Face Size: 24” x 24” for T-bar ceilings.
6. Mounting: Border Type 3 for lay-in ceilings, Border Type 1 for surface-mounting and Border Type 6, beveled drop face, for exposed locations. Refer to Architectural Drawings for finish type.
7. Pattern: An inner core assembly consisting of fixed deflection louvers shall be available in 1, 2, (2-way opposite and 2-way corner) 3, or 4-way horizontal discharge patterns. The inner core assembly must be removable in the field without tools for easy installation or cleaning.

2.2 REGISTERS AND GRILLES

A. Heavy Duty Register:
1. Basis-of-Design Product: The manufacturer shall provide published performance data for the grille. The grille shall be tested in accordance with ANSI/ASHRAE Standard 70-1991. Subject to compliance with requirements, provide Titus Model 33-R, one-half-inch bar spacing and 38 degree deflection or comparable product by one of the following:
   a. Metallaire, Inc.
   b. Krueger.
   c. Price Industries.

2. Material: Material shall be 16 gauge steel border and 14 gauge steel blades.
3. Finish: The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315 deg F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM D117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250 hour ASTM 0870 Water Immersion Test. The paint must also pass the ASTM D-2794 Reverse Impact Cracking Test with as 50-inch pound force applied.
4. Face Arrangement: As shown on the Device Schedule..

5. Deflection Bars: The fixed deflection bars shall be parallel to the long or short dimension (parallel with the floor) of the grille or register. Bars shall be 14 gauge steel. Bars shall be reinforced by perpendicular, steel support bars spaced on six-inch maximum centers.
6. Frame: One and one-quarter-inch border width on all sides and a minimum border gauge thickness of 16. Corners shall be welded with full penetration resistance welds with a reinforcing patch for extra strength.
7. Mounting Frame: Refer to Architectural Drawings for finish type.
8. Mounting: Countersunk screw.

B. Fixed Face Ceiling and Sidewall Return and Exhaust Grille:

1. Manufacturers: The manufacturer shall provide published performance data for the grilles. The grilles shall be tested in accordance with ANSI/ASHRAE Standard 70-1991. For filter return grilles, provide one-inch thick filters and 1/4-turn fasteners. Subject to compliance with requirements, provide Titus – Series 350 RL, Series 350 RLF1or comparable product by one of the following:
   a. Krueger.
   b. Price Industries.
   c. Metallaire, Inc.

2. Material: Construction shall be steel except for Science/Prep/Storage Rooms, Janitor Closets, Locker Rooms, Team Rooms, Shower Rooms, Kitchen and Dining Areas, which shall be aluminum.
3. Finish: The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315 deg F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM D117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250 hour ASTM 0870 Water Immersion Test. The paint must also pass the ASTM D-2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
4. Face Size: 24” x 24” for lay-in ceilings, as shown on Air Device Schedule (3/4” blade spacing).
5. Deflection Blades: The fixed deflection blades shall be parallel to the long dimension (or the floor for sidewall installations) of the register. Deflection blades shall be contoured to a specifically designed and tested cross-section to meet published test performance data. Blades shall be firmly held in place by mullions from behind the grille and fixed in place by crimping or welding. Blade deflection angle shall be available at 35 degrees.
6. Frame: One and one-quarter-inch border width on all sides and a minimum border gauge thickness of 16. Corners shall be welded with full penetration resistance welds with a reinforcing patch for extra strength.
7. Mounting Frame: Border Type 3 for lay-in ceilings, Border Type 1 for surface mount or exposed conditions. Refer to Architectural Drawings for finish type.
8. Mounting: Countersunk screw.

C. Adjustable Bar Supply Air Register (Standard Type)
1. Basis-of-Design Product: The manufacturer shall provide published performance data for the diffuser. The register shall be tested in accordance with ANSI/ASHRAE Standard 70-1991. Subject to compliance with requirements, provide Titus 300RS, double deflection register or comparable product by one of the following:
   a. METALAIRE, Inc.
   b. Price Industries.
   c. Krueger.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Register shall be constructed of steel with 1-1/4” wide border on all sides.
4. Finish: The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315 deg F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a

100-hour ASTM D117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250 hour ASTM 0870 Water Immersion Test. The paint must also pass the ASTM D-2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

5. Mounting: Shown on air device schedule.
6. Deflection: Double deflection with blades spaced on 3/4" centers. Blades shall have steel friction pivots on both ends to allow for individual blade adjustment. Front blades shall be parallel t the short dimension.
7. Accessories:

    a. Equalizing grid.
    b. Volume Extractor AG-45 with operator.

D. Adjustable Bar Supply air Register (Spiral Duct-Mounted Register):
1. Basis-of-Design Product: The manufacturer shall provide published performance data for the diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991. Subject to compliance with requirements, provide Titus S300FS direct duct-mounted, double deflection with radius end caps or comparable product by one of the following:
    a. METALAIRE, Inc.
    b. Price Industries.
    c. Krueger.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Diffuser shall be constructed of heavy duty extruded aluminum frame with 1-3/8" wide border and radius end caps with foam gaskets. Blades shall be constructed of heavy gauge extruded aluminum, 3/4" spacing and face blades parallel to the short dimension. Blades shall be individually adjustable.
4. Finish: The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315 deg F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM D117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250 hour ASTM 0870 Water Immersion Test. The paint must also pass the ASTM D-2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
5. Mounting: Shown on air device schedule.
6. Pattern: The airflow discharge pattern shall be field adjustable from horizontal to vertical by rotating a ring operator to open (vertical discharge) or close (horizontal discharge) the inner vane assembly. The inner vane assembly must be easily removable as a unit. The ring operator shall be adjustable with a pole of remote access.
7. Dampers: Round damper shall be constructed of heavy gauge steel. Damper must be operable from the face of the diffuser by removing the inner vane assembly.
8. Accessories:

    a. Air Scoop Damper Model ASD.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

D. Supply diffusers shall be square neck type with contractor fabricated internally lined plenum boxes.

E. Diffusers located in corridors shall be two-way blow type.

F. All terminal air devices located in science rooms, science prep rooms, kitchen, shower rooms, janitor closets, food prep areas, and mechanical/electrical equipment rooms shall be constructed of aluminum.

G. All terminal air devices shall be painted white unless indicated otherwise.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

SECTION 236200 - PACKAGED COMPRESSOR AND CONDENSER UNITS

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 packaged, refrigerant compressor and condenser units.

1.3 SUBMITTALS

A. Product Data: For each compressor and condenser unit. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.

B. Shop Drawings: For compressor and condenser units. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Drawings: 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:

1. Structural members to which compressor and condenser units will be attached.
2. Liquid and vapor pipe sizes.
3. Refrigerant specialties.
4. Piping including connections, oil traps, and double risers.
5. Compressors.
6. Evaporators.

D. Field quality-control reports.

E. Operation and Maintenance Data: For compressor and condenser units to include in emergency, operation, and maintenance manuals.

F. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of compressor and condenser units and are based on the specific system indicated. See Division 01 Section "Product Requirements."

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. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Standard for Refrigeration Systems."

D. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6, "Heating, Ventilating, and Air-Conditioning."

1.5 COORDINATION

A. Coordinate sizes and locations of structural steel supports.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

C. Coordinate location of piping and electrical rough-ins.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of compressor and condenser units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Compressor failure.
b. Condenser coil leak.

2. Warranty Period: Five years parts, labor and refrigerant from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COMPRESSOR AND CONDENSER UNITS, AIR COOLED

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Daiken International.
2. Trane; a business of American Standard Companies.
3. Carrier.

B. Description: Factory assembled and tested, air cooled; consisting of casing, compressors, condenser coils, condenser fans and motors, and unit controls.

C. Compressor: Hermetic scroll compressor designed for service with crankcase sight glass, crankcase heater, and backseating service access valves on suction and discharge ports.
1. Capacity Control: Hot-gas bypass and compressor staging to allow operation to 10% of full load.
2. Minimum independent refrigeration circuits; Two.

D. Refrigerant: R-410A.

E. Condenser Coil: Seamless copper-tube, aluminum-fin coil, including subcooling circuit and backseating liquid-line service access valve. Factory pressure test coils, then dehydrate by drawing a vacuum and fill with a holding charge of nitrogen or refrigerant. Provide condenser coil guard.

F. Condenser Fans: Propeller-type vertical discharge; directly driven. Include the following:

1. Permanently lubricated, ball-bearing totally enclosed motors.
2. Separate motor for each fan.
3. Dynamically and statically balanced fan assemblies.

G. Operating and safety controls include the following:

1. Manual-reset, high-pressure cutout switches.
2. Automatic-reset, low-pressure cutout switches.
3. Low-oil-pressure cutout switch.
4. Compressor-winding thermostat cutout switch.
5. Three-leg, compressor-overload protection.
6. Control transformer.
7. Magnetic contactors for compressor and condenser fan motors.
8. Timer to prevent excessive compressor cycling.
9. Phase loss protection.

H. Accessories:
1. Gauge Panel: Package with refrigerant circuit suction and discharge gages.
2. Hot-gas bypass kit.
3. Part-winding-start timing relay, circuit breakers, and contactors.
4. Reversing valve.
5. Anti-Short Cycle Timer.
6. Time Delay Relay to prevent compressors coming on line simultaneously.
7. Suciton service valve.
8. 24V Control: Unit shall be equipped with a 24 V terminal strip for field supplied and installed controls. The manufacturer shall provide all necessary relays for cooling stages.

I. Unit Casings: Designed for outdoor installation with weather protection for components and controls and with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features include the following:

1. Steel, galvanized or zinc coated, for exposed casing surfaces; treated and finished with manufacturer's standard paint coating.
2. Perimeter base rail with forklift slots and lifting holes to facilitate rigging.
3. Gasketed control panel door.
4. Nonfused disconnect switch, factory mounted and wired, for single external electrical power connection.
5. Condenser coil louvered panels.

J. Capacities and Characteristics: Refer to Drawings.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate compressor and condenser units according to ARI 340/360 and 365.

B. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1-2004, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," Section 6, "Heating, Ventilating, and Air-Conditioning."

C. Test and inspect shell and tube condensers according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. Testing Requirements: Factory test sound-power-level ratings according to ARI 270 and ARI 370.

E. The complete unit shall be UL listed.

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 compressor and condenser 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 compressor and condenser 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.

C. Vibration Isolation: Mount compressor and condenser units on rubber pads with a minimum deflection of 1/4 inch (6.35 mm). Vibration isolation devices and installation requirements are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Vibration Isolation: Mount compressor and condenser units on restrained spring isolators with a minimum deflection of 1-inch. Vibration isolation devices and installation requirements are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

E. Maintain manufacturer's recommended clearances for service and maintenance.

F. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.3 CONNECTIONS

A. Comply with requirements for piping in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

C. Connect precharged refrigerant tubing to unit's quick-connect fittings. Install tubing so it does not interfere with access to unit. Install furnished accessories.

D. Connect refrigerant piping to air-cooled compressor and condenser units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Division 23 Section "Refrigerant Piping."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.
2. Leak Test: After installation, charge system 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 motor operation and unit 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.

C. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

D. Compressor and condenser units will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 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 and perform the following:

a. Inspect for physical damage to unit casing.
b. Verify that access doors move freely and are weathertight.
c. Clean units and inspect for construction debris.
d. Verify that all bolts and screws are tight.
e. Adjust vibration isolation and flexible connections.
f. Verify that controls are connected and operational.

B. Lubricate bearings on fan motors.

C. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

D. Adjust fan belts to proper alignment and tension.

E. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.

F. Measure and record airflow and air temperature rise over coils.

G. Verify proper operation of condenser capacity control device.

H. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

I. After startup and performance test, lubricate bearings.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain compressor and condenser units.

END OF SECTION 23 62 00

SECTION 260501 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL

A. Provide all labor, materials, equipment and services necessary for and incidental to the complete installation and operation of all electrical work.

B. All work under this Division is subject to the General Conditions and Special Requirements for the entire contract.

C. Unless otherwise specified, all shop drawings and submissions required under Division 26 shall be made to, and acceptances and approvals made by, the ENGINEER.

D. Conform to the requirements of all rules, regulations, and codes of local, state, and federal authorities having jurisdiction. Conform to the National Electrical Code and all NECA – National Electrical Installation Standards (NEIS).

E. Perform the work in a first-class, substantial, and workmanlike manner. Any materials installed which do not present an orderly and neat workmanlike appearance shall be removed and replaced when so directed by the Engineer, at the Contractor's expense.

F. Coordinate the work of all trades.

G. Arrange conduit, wiring, equipment, and other work generally as shown, providing proper clearances and access. Carefully examine all contract drawings and fit the work in each location without substantial alteration. Where departures are proposed because of field conditions or other causes, prepare and submit detailed drawings for approval in accordance with “Submittals” specified below. The right is reserved to make reasonable changes in location of equipment, conduit, and wiring up to the time of rough-in or fabrication.

H. The contract drawings are generally diagrammatic and all offsets, bends, fittings, and accessories are not necessarily shown. Provide all such items as may be required to fit the work to the conditions.

I. Be responsible for all construction means, methods, techniques, procedures, and phasing sequences used in the work. Furnish all tools, equipment and materials necessary to properly perform the work in a first class, substantial, and workmanlike manner, in accordance with the full intent and meaning of the Contract Documents.

J. The Contractor shall provide other work and services not otherwise included in the Contract Documents that are customarily forwarded in accordance with generally-accepted construction practices.

K. Mechanical and Electrical contractors shall be registered Service Providers under Utility Company’s Energy Solutions for Business program. If either contractor is not registered as an approved Service Provider they must complete the online registration through the Utility Company’s Solutions for Business website.

1.2 PERMITS, INSPECTIONS, AND FEES:

1. The Contractor shall obtain and pay for all charges and fees, and deliver all permits, licenses, certificates of inspection, etc., required by the authorities having jurisdiction. Deliver inspection, approval, and other certificates to the Owner prior to final acceptance of the work.

B. File necessary plans, prepare documents, give proper notices, and obtain necessary approvals.

C. Permits and fees shall comply with the General Requirements of the Specification.

D. The Owner will pay for the building permit.

E. Notify Inspection Authorities to schedule inspections of work. All work shall be subject to field inspections.

F. Notify Architect in advance of scheduled inspections.

G. An electrical foreman, superintendent or other supervisor shall be in attendance for all scheduled inspections.

H. The Contractor shall provide an electrical certificate from an independent electrical inspection agency approved by the Owner and the State Fire Marshal. The Contractor shall submit certificate prior to final payment invoice. The Contractor shall pay all fees, including filing fees.

1.3 ELECTRICAL WORK UNDER OTHER DIVISIONS:

A. Mechanical Equipment and Systems

1. In general, power wiring and motor starting equipment for mechanical equipment and systems are furnished and installed under Electrical Division 26.
2. Certain mechanical units contain starters, contacts, transformers, fuses, wiring, etc., required for fans, pumps, etc., furnished with the equipment from the factory. When this equipment is supplied from the factory, the Contractor must supply power circuit(s) to the unit and a disconnecting means. Coordinate with Contractor so that one, and only one, set of starters, fuses, switches, etc., is provided and installed.
3. In general, control and interlock equipment for HVAC systems (including associated wiring, conduit, transformers, relays, contacts, etc.) is furnished under Mechanical Divisions. Contractor shall install and connect all such equipment as necessary.
4. Controls, wiring, conduit, transformers, etc., for smoke, fire, and motor-operated dampers are provided by Mechanical Contractor. Electrical shall install and connect all such equipment.

B. Architectural Equipment: In general, any electrically operated or controlled equipment furnished under architectural divisions shall be supplied with control wiring, transformers, contacts, etc. Contractor shall provide power circuits to such equipment and install all electrical control equipment related thereto.

C. Carefully review the contract documents and coordinate the electrical work under the various Divisions.

1.4 CONTRACTOR QUALIFICATION:

A. Any Contractor performing work under this Division shall be fully qualified and acceptable to the Engineer. Submit the following evidence for approval:

1. A list of not less than five (5) comparable projects that the Contractor completed.

2. Letters of reference from not less than three (3) registered professional engineers, contractors, or building owners, explaining Contractor proficiency, quality of work, or other attribute on projects of similar size or substance.
3. Local or State license.
4. Membership in trade or professional organization where required.
5. Copy of Master Electrician's License.

B. Contractor is any individual, partnership, corporation, or firm performing work by Contract or subcontract on this project.

C. Acceptance of a subcontractor will not relieve the Contractor of any contractual requirements or his responsibility to supervise and coordinate the various trades.

D. Supervisory Qualifications: The electrical work on the project shall be under the direct supervision of a licensed Master Electrician.

E. Qualifications of Installers:

1. For the actual fabrication, installation, and testing of the work, the Contractor shall use only thoroughly trained and experienced personnel who are completely familiar with the requirements of this work and with the installation recommendations of the manufacturers of the specified items.
2. The Electrical Installer shall utilize a full-time project foreman in charge of all electrical work. This person shall be fully qualified and experienced in such work and shall be available, on site, at all times during Construction. All problems, questions, coordination, etc., relating to electrical work shall take place through this person to the Architect.

F. Qualifications of Video Tape Technician: For videotaping specified in "Operating Instructions", the Contractor shall provide the services of persons skilled in videotape production and editing.

1.5 FIRE SAFE MATERIALS:

A. Unless otherwise indicated, materials and equipment shall conform to UL, NFPA, or ASTM Standards for Fire Safety with Smoke and Fire Hazard Rating not exceeding flame spread of 25 and smoke developed of 50.

1.6 REFERENCED STANDARDS, CODES, ORDINANCES AND SPECIFICATIONS

A. Specifications, Codes and Standards listed below are included as part of this specification, latest edition.

ADA	Americans with Disabilities Act
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
IBC	International Building Code

CABO	Council of American Building Officials
FM	Factory Mutual
IEEE	Institute of Electrical and Electronics Engineers
MOSHA	Maryland Occupational Safety & Health Administration
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety & Health Administration
BGE	Baltimore Gas and Electric
UL	Underwriters Laboratories

B. All electrical equipment and materials shall comply with the Codes and Standards listed in the latest edition of IEEE Standard 241, *Electric Power Systems in Commercial Buildings*, Chapter 1, Section 1.6, entitled "Codes and Standards".

C. Comply with all Codes applicable to the work:

1. Bidders shall inform themselves of all local and state codes and regulations.
2. In case of conflict between Contract Documents and governing Codes, the most stringent shall take precedence. Where, in any specific case, different sections of any applicable codes or when Drawings and Specifications specify different materials, methods of Construction, or other requirements, the most restrictive shall govern.
3. Where Contract Documents exceed minimum Code requirements, and are permitted under the Code, the Contract Documents take precedence and shall govern.
4. No extra payment will be allowed for work or changes required by local Code enforcement authorities.

D. Underwriters Laboratories Labels shall apply to all materials and devices, etc., except specified items not covered by existing UL Standards.

E. Conflicts with applicable regulations:

1. Resolve at Contractor's expense.
2. Prepare and submit details of alternate construction:

    a. Acceptable solution of conflict.
    b. List of substitute materials:

    For approval of inspecting authorities.
    For approval of Engineer.

F. Comply with all NECA's National Electrical Installation Standards (NEIS), including NECA 1-2000 "Standard Practices for Good Workmanship in Electrical Contracting".

1.7 INTERPRETATION OF DOCUMENTS

A. Any discrepancies between Drawings, Specifications, Drawings and Specifications, or within Drawing and Specifications shall be promptly brought to the attention of the Owner during the bidding period. No allowance shall subsequently be made to the Contractor by reason of his failure to have brought said discrepancies to the attention of the Owner during the bidding period or of any error on the Contractor's part.

B. The locations of products shown on Drawings are approximate. The Contractor shall place the devices to eliminate all interference with above-ceiling ducts, piping, etc. Where any doubt exists, the exact location shall be determined by the Owner and Architect.

C. All general trades and existing conditions shall be checked before installing any outlets, power wiring, etc.

D. Equipment sizes shown on the Drawings are estimated. Before installing any wire or conduit, the Contractor shall obtain the exact equipment requirements and install wire, conduit, or other item of the correct size for the equipment actually installed. However, wire and conduit sizes shown on the Drawings shall be taken as a minimum and shall not be reduced without written approval from the Architect/Engineer.

E. Where variances occur between the drawings and specifications or within either document itself, the item or arrangement of better quality, greater quality, or higher cost shall be included in the Contract Price. The Engineer will decide on the item and manner in which the work shall be installed.

F. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions, and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered. Arrange conduits, equipment, and other work generally as shown on the Contract Drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed Shop Drawings for approval in accordance with "submittals" specified below. The right is reserved to make reasonable changes in location of equipment, piping, and ductwork, up to the time of rough-in or fabrication.

G. Work not specifically outlined, but reasonably incidental to the completion of the work, shall be included without additional compensation from the Owner.

1.8 CUTTING AND PATCHING

A. The cutting of walls, floors, partitions, etc., for the passage and/or accommodation of conduits, etc., the closing of superfluous openings and the removal of all debris caused by said work under this contract shall be performed by and at the expense of the Electrical Contractor.

B. No cutting of any structure or finishes shall be done until the condition requiring such cutting has been examined and approved by the Architect.

C. All surfaces disturbed as a result of such cutting shall be restored under this division to match original work and all materials used for any patching, mending or finishing must conform to the class of materials originally installed.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Material and equipment installed as a part of the permanent installation shall be new, unless otherwise indicated or specified, and shall be approved by the Underwriters' Laboratories, Inc., for installation in each particular case where standards have been established.

B. Where material or equipment is identified by proprietary name, model number, and/or manufacturer, furnish the named item or equivalent thereof, subject to acceptance.

C. Material submissions shall conform to requirements outlined in SUBMITTALS, REVIEW, AND ACCEPTANCE.

D. The suitability of named item only has been verified. Where more than one Manufacturer is named, only the first named Manufacturer has been verified as suitable alternate. Manufacturers and items other than the first named shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of alternate manufacturers for review. Provide a list company proposed and specified products and performance on the first page of the submittal. Failure to clearly identify differences will result in the submittal being returned as “Revise and Resubmit”. The Contractor, by providing other than the first named Manufacturer, assumes responsibility for all necessary adjustments and modifications necessary for a satisfactory installation.

E. The Contractor shall only submit those manufacturers indicated in the Specification. Proposed manufacturers other than those indicated will not be considered unless the specific item indicates “or as approved equal”. Submit all data necessary to determine suitability of substituted items for approval. Failure to do so will result in a “Revise and Resubmit” response.

F. All items of equipment furnished shall have a service record of at least five (5) years.

2.2 SUBSTITUTIONS

A. Substitutions will be considered, subject to compliance with requirements of this section, under provisions of Section 01 63 20 – Products and Substitutions

2.3 SUBMITTALS, REVIEW, AND ACCEPTANCE

A. General:

1. The equipment, material, installation, workmanship, arrangement of work, final instruction, and final documentation is subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Engineer to be in the best interest of the Owner. Submit for review in clear and legible form the following documents:

    a. Material and Equipment List
    b. Descriptive Data
    c. Shop Drawings
    d. Installation and Coordination Drawings
    e. Contractor As-Built Drawings
    f. Owner Instructions and Manuals
    g. Construction Phasing and Outage Schedule

2. Prepare all submittals specifically for this project and stamp each submittal in a form indicating that the documents have been Contractor reviewed, are complete, and are in compliance with the requirements of the plans and specifications. Each submittal item shall be clearly identified and numbered. Each submittal shall contain a complete schedule of Manufacturer's part numbers and quantity listings of all supplied components. Each proposed item shall be highlighted and tagged with a star, an arrow, etc., including all options and accessories.
3. Coordinate the installation requirements and any mechanical requirements for the equipment submitted. Submittals will be reviewed for general compliance with design concept in accordance with the contract documents. The Contractor is responsible for the correctness of all submittals. Reviews will not verify dimensions, quantities, or other details.
4. Identify all submittals, indicating the intended application, location, or service of the submitted item. Refer to specification sections or paragraphs where applicable. Clearly indicate the exact type, model number, size, and special features of the proposed item. Clearly list on the first page of the Submittal all differences between the specified item and the proposed item. The Contractor shall be responsible for corrective action (or replacement with the specified item) while maintaining the specification requirements, if differences have not been clearly indicated in the submittal. Submittals of a general nature will not be acceptable.
5. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Indicate all options used to meet the specifications. It is not the responsibility of the Engineer or Owner to make selections of factory options other than colors. Submittals lacking proper selection of factory options or special features required by the specification shall be RETURNED WITHOUT REVIEW.
6. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted.
7. Documents of general form indicating options shall be clearly marked to show what is specifically proposed for this project.
8. Submittals NOT IN COMPLIANCE with the requirements of this section will be RETURNED WITHOUT REVIEW.

B. Material, Equipment, Manufacturer and Subcontractor List: Within 30 calendar days after the award of contract, submit a complete MATERIAL, EQUIPMENT, MANUFACTURER AND SUBCONTRACTOR LIST for preliminary review. List all proposed materials and equipment, the associated proposed Manufacturer, and any proposed subcontractors. After the receipt of reviewed Material and Equipment List, submit complete Shop Drawings for approval. List all materials and equipment, indicating manufacturer, type, class, model, curves, and other general identifying information. Submittals shall be specific for each building as contained in the individual building Specifications and Drawings.

C. Upon approval of the List of Materials, the Contractor shall prepare a complete Master Submittal Register, listing all products and materials that will be submitted for approval. Items shall be listed by referenced specification paragraph in ascending order. This master list shall be included with each submittal, updated to reflect the status of approval for each item, and shall highlight the items pertaining to the submittal. A suggested Submittal Register Format is shown below:

SUBMITTAL REGISTER					
Item/Material	Ref'd Spec. Paragraph	Specified or Substitute	Submittal Date	Status	Remarks

SUBMITTAL REGISTER					

D. No Shop Drawing Submittals will be considered for approval until the complete List of Subcontractors and the complete List of Materials/Manufacturers and Equipment have been approved.

E. Descriptive Data: After acceptance of the MATERIAL and EQUIPMENT LIST, submit additional DESCRIPTIVE DATA for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, installation instructions, and any other information necessary to indicate complete compliance with the contract documents. Where several ratings or sizes are shown or available, clearly indicate the exact size or rating relating to the particular device being proposed.

F. Submit complete descriptive data for all items. Data shall consist of Specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, specific electrical/wiring requirements and connections including control and interlock wiring, installation instructions, and any other information necessary to indicate complete compliance with the Contract Documents. Edit submittal data specifically for application to this project.

G. Shop Drawings shall be submitted and approved for all materials and equipment prior to installation. If any material and/or equipment is installed prior to receipt by the Contractor of approved Shop Drawings, the Contractor is liable for its replacement at no additional cost to the Owner.

H. Data submitted shall include information on all materials and equipment to demonstrate compliance with the Contract Drawings and Specifications. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

I. Any deviation of submitted material or equipment from the Contract Drawings or Specifications shall be clearly marked in red ink on Submittals, and itemized in a transmittal letter, in order to receive consideration for approval.

J. Approval of material or equipment submittals containing deviations not specifically identified by Contractor shall not relieve the Contractor from compliance with specified requirements.

K. Thoroughly review and stamp all submittals to indicate compliance with Contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals.

L. Submittals will be reviewed for general compliance with design concept in accordance with Contract Documents, but dimensions, quantities, or other details will not be verified.

M. Increase, by the quantity listed below, the number of electrical related Shop Drawings, product data, and samples submitted, to allow for required distribution plus two copies of each submittal required, which will be retained by the Electrical Consulting Engineer.

1. Shop Drawings - Initial Submittal: 1 additional blue- or black-line print.
2. Shop Drawings - Final Submittal: 1 additional blue- or black-line print.

3. Product Data: 1 additional copy of each item.

N. Additional copies may be required by individual sections of these Specifications.

O. Shop Drawings (include but not limited to):

1. Prepare and submit SHOP DRAWINGS AND/OR DIAGRAMS for all specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown on the contract drawings.
2. Shop drawings shall include plans, elevations, sections, mounting details of component parts, point to point interconnection diagrams, elementary diagrams, single line diagrams, and any other drawings necessary to show the fabrication and connection of the complete item or system.
3. Shop drawings shall be provided for, but not limited to the following items:

Analysis and Coordination Study
Automatic Transfer Switches
Ballasts
Basic Electrical Materials
Cable - 600 volt
Cable – Medium Voltage
Cable Tray
Circuit Breakers
Conduit and Surface Raceway
Contractor and Subcontractor Qualifications
Controllers & Control Devices
Disconnects
Electrical Connection Coordination Schedule
Engine/Generator
Equipment Connections
Equipment Pads
Excavation and Backfill
Fire Alarm Systems
Firestopping
Fuses
Ground Conductors, Rods
Identification System
Innerduct
Lamps
Lighting Control Equipment
Lighting Fixtures
Low Voltage Fuses
Material and Equipment List
Motor Starters
Occupancy Sensors
Outlet Boxes
PA System
Panelboards
Receptacles
Record and Information Booklet
Safety Switches
Schedule of Values
Sleeves, Hangers, Supports
Sound Systems
Special Systems

Submittal Schedule
Surge Protection Devices
Switchboards
Tests and Reports
Transformers
Underground Cable
Wiring Devices
Wiring Diagrams

P. The Contractor, additionally, shall submit for approval any other shop drawings as required by the Architect. No item listed above shall be delivered to the site, or installed, until approved. After the proposed materials have been approved, no substitution will be permitted except where approved by the Engineer.

Q. The Contractor shall prepare and submit a Detail Schedule of Values indicating the Contract costs for the major work items. The Contractor shall provide additional detail and information as requested by the Engineer.

R. The Contractor shall prepare and submit a complete Submittal Schedule. The Schedule shall include a listing of all Submittals, Shop Drawings, and Coordination Drawings.

S. The Contractor shall review and coordinate with all other not order major electrical gear that serves HVAC and plumbing motors until all HVAC and plumbing equipment with motors have been reviewed. Additionally the Contractor shall review all mechanical and plumbing submittals for coordination items (disconnect switch, capacitors, etc.) prior to the Mechanical Contractor submitting products for review.

2.4 INSTALLATION AND COORDINATION DRAWINGS:

A. Prepare, submit, and use composite installation and coordination drawings to assure proper coordination and installation of the work. Drawings shall include, but not be limited to the following:

1. Telecommunication Rooms indicating data rack assemblies, panels, etc.
2. Electrical Rooms indicating switchboard assemblies, transformers, equipment pads, panels, etc.
3. Mechanical Equipment Rooms, including panels, transformers, starters, equipment, etc.
4. Cable tray, light fixtures.

B. Draw plans to a scale not less than 1/4 inch equals one foot. Include plans of the proposed work, showing all equipment, major elements, conduit, and wiring in the areas involved. Fully dimension all work, horizontally and vertically. Show coordination with other work including piping, ductwork and other mechanical work, walls, doors, ceilings, columns, beams, joists, and other architectural and structural work.

C. Identify all equipment and devices on wiring diagrams. Where field connections are shown to factory-wired terminals, furnish manufacturer's literature showing internal wiring.

D. Prepare, submit, and use scaled layout drawings indicating dimensions, clearances, and actual equipment dimensions. Layout drawing shall include, but not be limited to the following:

1. Pad-mounted equipment and equipment connections.
2. Underground conduits, ductbanks, manholes, handholes, and building penetrations.

E. The Electrical Contractor shall develop and prepare an AutoCAD or Revit coordination model for the entire building to be used in conjunction with the mechanical, plumbing, structural and archi

tectural model for coordination purposes. Model shall include major above ground feeders (2" and larger) cable trays, light fixtures, etc.

F. The Mechanical Contractor shall schedule bi-weekly Coordination Drawing Reviews with the Owner, Mechanical Engineer, and all associated subcontractors, including but not limited to the following:

1. Mechanical Contractor
2. Finishes Contractor
3. Sheet Metal Contractor
4. Sprinkler Contractor
5. Electrical Contractor
6. Plumbing Contractor
7. Owner/Architect/Engineer
8. Commissioning Agent
9. Note: A Foreman or Project Manager responsible for Decision-Making of each company shall attend all Coordination Meetings.

G. The purpose of these meetings is to coordinate proposed installations of systems and equipment, including clearances, routing, penetrations, as well as to review potential conflicts. The Mechanical Contractor shall base preliminary equipment sizes and connections on proposed products and the final coordination drawing for review shall reflect approved/reviewed products. Coordination Meetings shall be held at the Contractor's Field Office.

2.5 RECORD DRAWINGS:

A. As the work progresses, record on a set of white prints the installed locations, sizes of electric feeders, equipment, etc. Upon completion of the work, submit one (1) complete set of white prints with "As-Built" information neatly recorded thereon in red ink. Use other colors to distinguish between variations in separate categories of the work. Note related change-order numbers where applicable. Provide electronic copies to the owner and architect at the completion of the project.

B. Write step-by-step detailed instructions for turn-on, turn-off, seasonal changeover, and periodic checks of all systems and equipment. Include all precautions and warnings.

C. Prepare a list of the manufacturers of all major equipment, their local service representative and procedures for obtaining service.

D. Post one (1) copy of all instructions, lists, charts, and diagrams at the equipment or where indicated, mounted under glass or approved plastic cover.

E. Furnish to the Owner two (2) copies of the Manufacturer's installation and operations instructions, and an electronic copy. Include replacement parts lists where applicable. Also include copies of all posted instructions, lists and charts. Assemble the material in one or more heavy duty 8- 1/2" x 11" loose leaf binders with tab separators. Submit for approval before final delivery. Binder shall be labeled on spine and on cover with Project Name.

F. Deliver all instruction materials to the Owner prior to the formal instruction period.

G. Deliver two (2) complete sets of all approved submittals to the Owner for filing, including electronic copies.

H. Prepare record documents in accordance with the requirements in the specifications. In addition to the requirements specified, indicate installed conditions for:

1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and circuit breaker size and arrangements.
2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Approved Substitutions, Contract Modifications, and actual equipment and materials installed.

I. The Contractor shall keep at the site at all times during construction, one set of up-to-date Contract prints for the express purpose of showing any and all changes made during construction. The Contractor shall make the prints showing each change and shall incorporate all changes in “Record/As-Built Drawings” to be submitted to the Engineer upon completion of the project.

J. The Contractor shall show proof of up-to-date record drawings to the Owner prior to submitting monthly invoice.

K. The Contractor shall conform to all drawings, including all revisions, addendums, alternates, change orders, deletions, existing conditions, and as-built conditions without extra cost to the Owner.

L. 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: Annotated PDF electronic file with comment function enabled.
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.
4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.

M. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
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.

2.6 DEMONSTRATION AND OPERATING INSTRUCTIONS

A. Furnish the necessary technicians, skilled workers, and helpers to operate the electrical systems and equipment of the entire project. The Contractor shall provide a minimum of three 2-hour ses

sions of system demonstration and operation for each system including, but not limited to: lighting controls, switchboards, generator, transfer switches.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Contractor shall provide start-up of all systems in an orderly, organized, and coordinated manner to ensure that all systems are functioning as designed. The Contractor shall provide a detailed start-up, testing, and demonstration plan for all systems in a coordinated manner that is documented in writing at least 45 days prior to system start-up. Start-up, testing and demonstration plans shall include detailed point-by-point checklists that clearly show that systems are, in fact, functioning as designed. Instruct the Owner or designated personnel in operation, maintenance, lubrication, and adjustment of systems and equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions, for use by Instructors and Owner personnel.

E. Videotape each instruction session, including both the sessions specified above and added sessions required in technical sections for specialized equipment. Provide one complete set of DVD video disks with each Operating and Maintenance Manual.

F. Schedule the general and specialized instruction periods for a time agreed upon by he Owner and Engineer. All operation training and demonstrations shall be complete prior to Owner acceptance of any given system.

PART 3 - EXECUTION

3.1 EXAMINATION OF SITE, SURVEYS, AND MEASUREMENTS:

A. Examine the site, determine all conditions and circumstances under which the work must be performed, and make all necessary allowances for same. No additional cost to the Owner shall be permitted for Contractor’s failure to do so.

B. Examine the site and observe the conditions under which the work will be done or other circumstances which will affect the contemplated work. No allowance will be made subsequently in this connection for any error or negligence on the Contractor's part.

C. The Contractor shall base all measurements, both horizontal and vertical, from established benchmarks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work.

D. Any discovery of discrepancy between actual measurements and those indicated which prevents following good practice or the intent of the Drawings and Specifications shall be brought to the attention of the Owner’s Representative. Work shall not proceed until receiving instructions from the Owner’s Representative.

E. The Contractor shall follow Drawings in laying out the work and check Drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions at all points. Where headroom or space conditions appear inadequate, the Owner’s Representative shall be notified before proceeding with the installation.

F. To prevent conflict with the work of other trades and for proper execution of the work, the Contractor, as directed by the Architect/Engineer, shall make the necessary modifications in the layout as needed, at no extra charge to the Owner.

G. The Contractor shall be solely responsible for the proper arrangement of his conduit and equipment.

H. The Engineer shall make all final decisions as to any conditions that require the changing of any work.

I. The Contractor shall have competent supervision on the site at all times to lay out, check, coordinate, and supervise the installation of all electrical work and be responsible for the accuracy thereof. He shall plan the installation of all electrical work, giving consideration to the work of other trades, to prevent interference.

J. The Contractor shall determine the location, size, etc., of all chases, sleeve openings, etc., required for the proper installation of the electrical work and see that such are provided. All chases, sleeves, openings, etc., shall be set prior to erection of new work to prevent delay in the progress of other work or trades.

K. Conditions and/or situations that prevent the proper installation of any equipment or item where shown on the Drawings shall be called to the attention of the Engineer for instructions.

L. The Contractor shall have equipment shipped or fabricated in sections of suitable size for entering the building and being removed from the finished building in the future, if necessary.

M. The Contractor shall fully investigate all peculiarities and space limitations for all materials and equipment.

N. Outlet, pull, and junction boxes and other appliances that require operation, examination, adjustment, servicing or maintenance shall be readily accessible.

O. The Contractor shall take all field measurements necessary for this work and shall assume responsibility for their accuracy.

P. The Contractor shall coordinate the electrical work with all other sub-contractors. All work shall be so arranged that there will be no delay in the proper installation and completion of any part or parts of electrical equipment. All electrical work shall be installed in proper sequence with other trades without any unnecessary delay.

Q. The Drawings are to some extent diagrammatic and indicate the general arrangement of the equipment, the runs of conduit, and the manner of connection.

R. The Contractor shall confer with all sub-contractors engaged in the construction of the project, regarding the work that may, in any way, affect his installation. Whenever interference occurs, before installing any of the work in question, the Contractor shall consult with all sub-contractors and shall come to an agreement with them as to the exact location and level of his conduit parts of his equipment.

S. The Contractor shall be responsible for determining exact property lines and area of work. The Contractor shall not install any equipment or conduits outside of the property lines and/or area of work without written direction from the Owner. Any work indicated diagrammatically on the Contract Documents to be installed beyond the property lines and/or area of work shall be verified with the Owner prior to installation.

3.2 GENERAL RESPONSIBILITIES:

A. The Contractor shall be responsible for systems and related damages possible, and shall hold harmless the Owner, the Architect and his consultants from malfunction of systems and equip

ment installed under this Contract as defined in the laws of the State of Maryland pertaining to real property for the period of time as defined by such laws.

B. It is the intent of these Specifications to fully cover without exception all required labor and materials so that the finished work will be delivered to the Owner in a complete and satisfactory working installation. Excavation, wiring, distribution, etc., shall be performed in compliance with the Contract Documents.

C. Work not specifically outlined, but reasonably incidental to the completion of the work, shall be included without additional compensation from the Owner.

D. Conflicting points in the Specifications or on the Drawings shall be called to the attention of the Architect prior to the execution of the Contract.

3.3 STORAGE AND PROTECTION OF EQUIPMENT

A. All electrical equipment to be used in the construction shall be properly stored and protected against the elements. All equipment shall be stored under cover, and shall not be stored at the construction site on the ground, in mud, water, snow, rain, sleet or dust. Large diameter cables may be stored on reels with weatherproof materials. Such weatherproof materials shall be heavy-duty, securely fastened and made impervious to the elements.

B. Conventional electrical construction materials such as building wire, outlet and junction boxes, wiring devices, conduit, lighting fixtures, fittings, etc., shall be stored in construction buildings, covered trailers or portable covered warehouses. Any equipment subject to damage or corrosion from excessive moisture shall be stored in dry, heated areas. Any equipment containing plastic or material subject to damage caused by excessive heat or sunlight shall be stored to prevent such damage. This includes plastic ducts and lenses.

C. Switchboard, motor controllers, panelboards, breakers, emergency lighting, and supervisory equipment, if delivered to the construction site before the building is under cover, shall be warehoused and protected as follows: All gear and equipment shall be covered and protected from the elements and other damage and shall be stored in a clean, dry, heated atmosphere, under cover.

D. All gear and equipment delivered to the construction site after the building is under cover shall be protected as described above and in addition shall be provided with auxiliary heat to prevent condensation damage. The gear shall also be protected against damage caused by installation of any building systems and equipment; or damage caused by carelessness of workmen who are installing equipment connected to or adjacent to the above electrical equipment.

E. Equipment damaged as a result of the above conditions shall be properly repaired at the Contractor's expense or shall be replaced at the Contractor's expense, if, in the opinion of the Engineer the equipment has been damaged to such an extent it cannot operate properly after repairs are made.

F. All electrical enclosures exposed to construction damages such as paint spots, spackling or plaster spatter, grout splashes, waterproofing compound, tar spots or runs and pipe covering compound splashes, shall be completely covered and protected against damage.

G. In the event leakage into the building of any foreign material or fluid occurs or may occur, the Contractor shall take all steps as described above to protect any and all equipment.

H. After connections to electrical equipment are complete and the equipment is ready for operation, all construction debris shall be removed from all enclosures. Such debris includes dust, dirt, wire clippings, tape and insulation removed in order to make the connection.

3.4 ELECTRICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate electrical systems, equipment, materials, and installation with landscape/irrigation contractor(s).
2. Verify all dimensions by field measurements.
3. 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 Engineer.
4. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components where installed exposed in finished spaces.
5. Install electrical 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. All equipment and disconnects shall maintain proper working space to conform to NEC.
6. Install systems, materials, and equipment giving right-of-way priority to systems that require installation at a specified slope.
7. Arrange for chases, slots and openings in other building components during progress of construction, to allow for electrical installation.
8. Space, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work.

3.5 SUPERVISION AND COORDINATION:

A. Provide complete supervision, direction, scheduling and coordination of all work under the contract, including that of subcontractors, using full attention and the best skill. Be responsible for all work and make all subcontractors, suppliers and manufacturers fully aware of all requirements of the contract.

B. Coordinate the rough-in of all work performed under Mechanical & Electrical Divisions.

C. The Contractor shall coordinate all electrical rough-ins with approved shop drawings and coordination drawings. Any rough-in installed without complete coordination shall be at the Contractor’s risk and expense.

D. Coordinate the installation of all necessary rough-in of work, sleeves, anchors and supports for conduit, wiring, and other work performed under Divisions Mechanical and Electrical Divisions.

E. Coordinate the spacing and arrangement of lighting fixtures, diffusers, grilles and access panels in ceilings to establish a symmetrical pattern.

F. Where a discrepancy exists within the Specifications or drawings or between the Specifications and Drawings, the more stringent (or costly) requirement shall apply until a clarification can be obtained from the Engineer. Failure to clarify such discrepancies with the Engineer will not relieve the Contractor of the responsibility of conforming to the requirements of the Contract.

G. Failure of the Contractor to obtain a full and complete set of Contract Documents (either before or after bidding) will not relieve the Contractor of the responsibility of complying with the intent of the Contract Documents.

H. To insure proper electrical coordination between the electrical components supplied under the Electrical Divisions and the equipment supplied under the Mechanical Divisions, a schedule shall be submitted, prior to start of work and prior to fabrication of panels and/or gear which power is fed from, for review by the Engineer with the following column headings:

1. Equip. or Item	2. HP or KVA	3. Voltage and Phase	4. Power Factor	5. Capacitor	6. Motor Starter	7. Discon.	8.Controls	9.Remarks

Description of Column Headings:

1. List all the approved equipment furnished under Mechanical Division that requires electrical connections and designate the equipment as it appears in the Mechanical Divisions. Indicate the quantity, if more than one, in parentheses of identical equipment being supplied.
2. Indicate the supplied horsepower of the equipment listed under Column No. 1. If equipment listed has more than one motor, indicate each motor and its respective horsepower. Indicate the kVA rating for all other equipment requiring an electrical connection, unless the electrical connection is for a control circuit only.
3. Indicate the voltage and phase requirements for equipment listed under Column No. 1. If more than one electrical circuit or voltage is required for the listed equipment, it shall be so indicated. Indicate wiring required for connection, including all phase, neutral, and ground conductors.
4. Indicate the power factor rating for all motors listed under Column No. 2
5. Where a capacitor is to be provided, indicate specification it is supplied under and indicate the KVAR size for any capacitor provided under Division 26.
6. Where a motor starter is required, indicate the specification division it is supplied under and the type of motor starter; across-the-line, reversible, variable speed, two speed-single winding, etc. Indicate In Column No. 9 if the motor starter provided under Division 26 is not compatible with the motor specified.
7. Where a disconnect switch is required by the National Electric Code or by the contract documents for the equipment listed under Column No. 1, indicate under which Division the disconnect switch is supplied.
8. Indicate the Division under which the controls for the equipment listed under Column No. 1 are provided.
9. Indicate any discrepancies between what is indicated in the contract documents and what is actually being provided.

I. The Contractor shall fully coordinate the electrical connections to all equipment prior to installations, with the approved Shop Drawings and the trades involved. Coordination shall include voltage, phases, quantity and size of wiring, device sizes, terminations, rough-in work, and other coordination for a complete installation.

J. Coordinate Division 26 work with all trades.

K. Install work with proper clearances and access. 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. The right is reserved to make reasonable changes in location of equipment, conduit and wiring up to the time of rough-in or fabrication.

L. Coordinate light switch locations with door swings prior to rough-in. No switches permitted behind doors.

M. Coordinate electrical work with architectural items and equipment. Typical equipment refers to, but is not limited to, the following:

1. Countertops, Casework and Cabinets.
2. Fume and Exhaust Hoods.
3. Kitchen equipment.
4. Do not install outlets, switches, etc., behind casework, cabinets, etc.
5. Data, phone, and other low voltage system outlets shall be mounted above the counter tops to match power outlets in the same areas.
6. Coordinate counter top outlets with drilling of casework/counters.
7. Coordinate surface raceways and outlets above and below counters with approved casework shop drawings to avoid conflicts with sinks and other appurtenances.
8. Verify lab/kitchen equipment nameplates and connection requirements prior to rough-in.
9. Shop equipment connections, including busways.

N. This Contractor shall make all system connections required to equipment furnished and installed under other divisions. Connections shall be complete in all respects to render this equipment functional to its fullest intent. The Contractor shall make all system connections required to equipment furnished under other Divisions. Circuits shall be extended to all equipment which is incidental to, but not necessarily shown, for equipment specified under other divisions such as magnetic flow meters, ATC panels, liquid level controls, leak detection systems, etc. Connections shall be complete in all respects to render this equipment functional to its fullest extent. Coordinate quantity, locations and power requirement for all items with the mechanical, plumbing and general trades contractors.

O. It shall be the responsibility of the Contractor to obtain complete instructions for connections.

3.6 GUARANTEE:

A. Guarantee obligations shall be as hereinbefore specified in the GENERAL AND SPECIAL CONDITIONS of these specifications, except as follows:

1. Guarantee the complete electrical system free from all mechanical and electrical defects for the period of two (2) years beginning from the day of substantial completion of the work by the Architect. Refer to the Alternates specification section for additional years of guarantee. In all cases (base bid or alternates) specific equipment or materials warranties shall be guaranteed as stated hereinafter or as indicated on the drawings.
2. Also, during the guarantee period, be responsible for the proper adjustments of all systems, equipment and apparatus installed by the Contractor and do all work necessary to ensure efficient and proper functioning of the systems and equipment.
3. Upon receipt of notice from the Owner of failure of any part of the electrical installation during the guarantee period, new replacement parts shall be furnished and installed promptly at no cost.
4. Warranty From the Manufacturer: Contractor shall obtain all warranty papers and records from the Original Equipment Manufacturer according to their warranty policy and deliver the same to the Owner. Contractor shall fulfill all the Original Manufacturer's requirements to validate the warranty as offered by the Original Equipment Manufacturer.

B. Provide 24-hour service for any and all warranty problems experience in the operation of the equipment provided.

C. Any equipment or system in need of warranty work whether during regular hours or on an emergency basis, shall be immediately serviced and repaired. The warranty work and guarantee shall include all parts and labor and shall be furnished at no cost to the Owner.

D. The Contractor shall guarantee to make good any and all defects in his work, exclusive of lamps, which may develop due to defective workmanship or materials, within three years from the date of final acceptance of the work by the Owner.

E. In addition to the warranty and correction of work obligations contained in the General and supplementary Conditions, correct the work of the system as embraced by the Specification, free from Mechanical and Electrical defects for the warranty period beginning from the day of acceptance of the building by the Architect for the beneficial use of the Owner.

F. During the warranty period, take responsibility for the proper adjustments of systems, equipment and apparatus installed and perform work necessary to ensure the efficient and proper functioning of the systems and equipment.

G. Certain items of equipment hereinafter specified shall be guaranteed for a longer time than the general warranty period. These guarantees shall be strictly adhered to and the Contractor shall be responsible for service or replacement required in connection with guarantee of these items. These guarantees shall commence on the same date as the final acceptance by the Architect.

H. Submission of a bid proposal for this Project warrants that the Contractor has reviewed the Contract Documents and has found them free from ambiguities and sufficient for the construction and proper operation of systems installed for this project. If discrepancies are found, have them clarified by Addendum.

I. It is possible that certain areas of the building or certain systems will be accepted at a time different than as specified. The date of acceptance by the Architect for beneficial use of the Owner for these building areas or systems will be adjusted accordingly.

3.7 SCHEDULING OF WORK:

A. The Contractor shall not be permitted to do any work in any area of any occupied building during normal hours, except in areas specifically assigned.

B. Coordination of work by the Contractor is essential such that power outages are kept to a minimum in quantity and duration. All required outages shall be approved by the Owner for optimum time scheduling. Written notice of not less than 15 calendar days shall precede all power outages. Utility disruptions during normal school hours are prohibited.

3.8 TEMPORARY FACILITIES:

A. General: Refer to the Division 1 Sections for general requirements on temporary facilities.

B. Description: Furnish and install the necessary metering and distribution equipment or an adequate, 3-phase, 4 wire temporary service and all temporary wiring, including step-down or step-up dry-type transformers. Exact requirements for temporary service will be determined by the Contractor.

C. The Contractor’s attention is directed to the Occupational Safety and Health Act, Americans with Disabilities Act and NEC requirements for electrical work on construction sites.

D. Materials: Lights at each floor in each stair. At least one light outlet per 1200 square feet on each floor, exclusive of stairs.

1. One 20-ampere circuit for each 7500 square feet of gross floor area per floor to which various trades may attach their cords.
2. One temporary 220v power online in corridor (each elevator lobby) including connections to saws, fireproofing equipment and wood sanding equipment, if required.
3. Power for testing and operating of elevators.
4. Temporary lighting for stripping forms for all floors below grade.
5. Power for crane operation.

E. Installation: Temporary lighting shall provide minimum foot candle levels for construction as follows:

AREA	FOOT CANDLE LEVEL
General construction area lighting, corridors, hallways and exit ways.	10
Electrical equipment rooms, active storerooms, shops, locker and dressing areas	10

F. The Contractor shall pay for all material and labor to provide and maintain temporary service.

G. The Contractor shall obtain and shall pay for temporary electrical service for construction power.

H. Provide all underground and/or overhead equipment, transformers, overcurrent devices, wires, connections, etc., for obtaining power from utility company lines.

I. Remove all temporary power installations and connections after permanent power is established and/or prior to completion of the project.

J. Contractor responsible for any and all temporary utility power connection fees.

3.9 DEMONSTRATION:

A. As a part of this contract, the Contractor shall provide for the services of equipment manufacturers or their established representatives to demonstrate to selected maintenance personnel the correct operation, safety and maintenance of all electrical equipment under this contract.

3.10 PAINTING AND FINISHES:

A. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work. Paint bare, untreated ferrous surfaces with rust-inhibiting paint. All exterior components including supports, hangers, nuts, bolts, washers, vibration isolators, etc., shall be galvanized or stainless steel.

B. Clean surfaces prior to application of coatings, paint, or other finishes.

C. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pre-treatment.

D. Protect all finishes and restore any finishes damaged as a result of work under Division 26 to their original condition.

E. The preceding requirements apply to all work, whether exposed or concealed.

F. Remove all construction marking and writing from exposed equipment, conduit, and building surfaces. Do not paint manufacturer's labels or tags.

G. All exposed conduit, etc., shall be painted, except in electrical rooms, mechanical rooms, storage rooms, and crawl spaces. Colors shall be selected by the Architect and conform to ANSI Standards.

H. Submit color of factory-finished equipment for approval prior to ordering.

3.11 PROTECTION OF WORK:

A. Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment.

B. Cover temporary openings in conduit and equipment to prevent the entrance of water, dirt, debris, or other foreign matter.

C. Cover or otherwise protect all finishes.

D. Replace damaged materials, devices, finishes and equipment.

3.12 OPERATION OF EQUIPMENT:

A. Clean all systems and equipment prior to initial operation for testing, retesting, or other purposes. Set, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is authorized for operation during construction.

B. Where specified, or otherwise required, provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment.

C. Do not use electrical systems for temporary services during construction unless authorized in writing by the Owner. Where such authorization is granted, temporary use of equipment shall in no way limit or otherwise affect warranties or guaranty period of the work.

D. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items such as filters.

3.13 TESTING AND ADJUSTMENT

A. Perform all tests which are specified or required to demonstrate that the work is installed and operating properly. Where formal tests are required, give proper notices and perform all necessary preliminary tests to assure that the work is complete and ready for final test.

B. Adjust all systems, equipment and controls to operate in a safe, efficient and stable manner.

C. On all circuits, 600 volts or less, provide circuits that are free from ground faults, short circuits and open circuits.

D. Other tests of a specific nature for special equipment shall be as specified under the respective equipment.

3.14 IDENTIFICATIONS, ELECTRICAL DIAGRAMS AND OPERATING INSTRUCTIONS:

A. Contractor shall submit for approval schematic diagrams of each electrical system installed in the building. Diagrams shall indicate device location, service, type, make, model number and the identification number of each device in the particular system. Following approval by all authorities, the diagrams shall be framed, mounted under glass and hung in each Main Equipment Room where directed. Contractor shall deliver the tracing or sepia from which the diagrams were reproduced to the Owner.

B. All equipment shall be plainly tagged.

C. All items of equipment, including motor starters, panels, etc., shall be furnished with white letters and numbers on black plastic identification plates or aluminum letters and numbers on black engraved aluminum identification plates. Lettering shall be a minimum of 1/4" high. Identification plates shall be securely affixed to each piece of equipment, starters, panels, etc., by screws or adhesive (Tuff-Bond #TB2 or as approved equal). Pressure sensitive tape backing is prohibited.

D. Provide three (3) copies and electronic copies of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the "Record and Information Booklet" as hereinafter specified.

E. Provide at least 24 hours of straight time instruction to the operating personnel. This instruction period shall consist of not less than three (3) consecutive 8-hour days. Time of instruction shall be designated by the Owner. Provide two DVD/Digital copies of all instructional periods/demonstrations.

3.15 RECORD DRAWINGS AND SPECIFICATIONS:

A. Upon completion of the Electrical installations, the Contractor shall deliver to the Engineer one complete set of prints of the Electrical Contract Drawings which shall be legibly marked in red pencil to show all Addenda, approved Shop Drawings, Change Orders, changes and departures of the installation as compared with the original design. They shall be suitable for use in preparation of Record Drawings. Provide electronic copies of each.

B. The Contractor shall provide a record specification including all Addenda and other modifications. Record substantial variations in actual work performed. Identify all substitutions.

3.16 RECORD AND INFORMATION BOOKLET:

A. The Contractor shall have prepared three (3) copies of the Record and Information Booklet as well as an electronic copy and deliver these copies of the booklet to the Owner. The booklet shall be as specified herein. The booklet must be approved and will not be accepted as final until so stamped.

B. The booklet shall be bound in a three-ring loose-leaf binder similar to "National" No. 3881 with the following title lettered on the front and on the spine of the binder: "Record and Information Book

let (insert name of the project)". No sheets larger than 8-1/2" x 11" shall be used, except sheets that may be neatly folded to 8-1/2" x 11" and used as a pull-out. An Index will include the section tabs for each subject included. If more than one binder is required, print covers and spines with Volume numbers. Include in the front of every binder an index to all binders.

1. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
2. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on white paper.
3. Part 1: Directory, listing names, addresses, and telephone numbers of Electrical Engineers; Contractor; Electrical Subcontractors; and major Electrical equipment suppliers. Provide sales and service representative names and phone numbers of all equipment.
4. Part 2: Operation and Maintenance Instructions, arranged by Specification Section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:

    a. Significant design criteria.
    b. List of equipment. Complete record of material list. Catalog brochures and product data for all components. Include all submittal comments, and corrected catalog data and shop drawings on each piece of equipment and each system.
    c. Parts list for each component, including recommended spare parts list. Include motor starter overload schedules.
    d. Operating instructions, including sequence of operation.

        i. Description of function, normal operating characteristics and limitations, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts. Provide a description of each system installed.
        ii. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; control, stopping.

    e. Maintenance instructions for equipment and systems. Detailed checkout procedures to ensure operation of systems and gear, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
    f. Servicing, diagnostic and troubleshooting instructions and procedures for systems and major equipment.
    g. Recommended preventative maintenance program, including a list of items requiring inspection and servicing. Provide Chart Form indicating time and type of routine and preventative maintenance of electrical equipment, etc. The chart shall also indicate tag number, model number of equipment, location and service.

        i. For replacement items, indicate type, size and quantity of the replaceable items.
        ii. Provide lubrication schedule, including type, grade, temperature range and frequency.
        iii. Provide a list of each type of lighting fixture lamp used, lamp fixture used, and source.
        iv. Include estimated mean time between failures for major parts.

    h. Wiring Diagrams, Block Diagrams, and Assembly Drawings.

        i. Panelboard Circuit Directory for each panelboard, including Panel Name, Panel Location, Panel Ratings, spare circuit breakers, spaces for additional circuit breakers.
        ii. List of equipment keys turned over to the Owner.

5. Part 3: Project Documents and Certificates, including the following:

a. Shop Drawings and Product Data. Record Documents of the systems.
b. Photocopies of certificates.
c. Photocopies of Manufacturers' and Contractors' warranties, guarantees.
d. Test Reports: Copies of the approved results of all tests required under all sections of specifications.
e. Inspection Certificates.
f. Manufacturer's Conformance Certificates.

6. Provide one copy (DVD video disk) of video instruction session with each booklet set. Label video disk with all pertinent information.
7. Submit one copy of completed volumes in final form 15 days prior to final Inspection. This copy will be returned with Engineer comments. Revise content of documents as required prior to final submittal.
8. Submit final volumes revised and electronic copies, within ten days after final inspection.

C. Upon completion of the project, the Contractor shall furnish the Owner a complete list of suppliers of equipment for parts and maintenance purposes. The list shall include the name, address, and telephone number of the parts and maintenance firm on a single 8-1/2" x 11" sheet of paper.

D. This item shall include the furnishing of a complete list of equipment installed on the project, including the Manufacturer's name, the make and model number of the equipment, and address and telephone number of the nearest supplier who stocks maintenance and/or replacement parts. The list should be submitted along with as-built drawings and be typed in an organized manner.

END OF SECTION 260501

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Metal-clad cable, Type MC, rated 600 V or less.
3. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.
2. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers:

1. Alpha Wire Company.
2. American Bare Conductor
3. Belden, Inc.
4. Cerro Wire LLC
5. General Cable Technologies
6. Service Wire Co.
7. Southwire Company
8. WESCO

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Conductor Insulation:

1. Type NM: Comply with UL 83 and UL 719.
2. Type USE-2 and Type SE: Comply with UL 854.
3. Type THHN and Type THWN-2: Comply with UL 83.
4. Type XHHW-2: Comply with UL 44.

2.2 METAL-CLAD CABLE, TYPE MC, MC LUMINARY CABLE

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers:

1. AFC Cable Systems

2. Alpha Wire Company.
3. American Bare Conductor
4. Belden, Inc.
5. Cerro Wire LLC
6. General Cable Technologies
7. Service Wire Co.
8. Southwire Company
9. WESCO

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. RoHS compliant.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit.

E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

F. Ground Conductor: Insulated.

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.

H. Armor: Steel interlocked.

I. Jacket: PVC applied over armor.

2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers:

1. AMP Incorporated.
2. Buchanan.
3. General Signal; O-Z/Gedney Unit.
4. Monogram Company; AFAC.
5. NSI Industries, Inc.
6. Square D Company; Anderson.
7. 3M Company; Electrical Products Division.

C. Connectors:

1. Split Bolt & Set Screw Connectors: Not Acceptable.
2. Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.
3. Solderless Pressure Connectors: High copper alloy terminal. May be used only for cable termination to equipment pads or terminals. Not approved for splicing.
4. All wire connectors used in underground or exterior pull boxes shall be gel-filled twist connectors or a connector designed for damp and wet locations.
5. Compression (crimp) Connectors: Long barrel; seamless, tin-plated electrolytic high conductivity copper tubing, internally beveled barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of crimps. Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.
6. Heat shrinkable tubing shall meet the requirements of ANSI C119.1-1986 for buried connections to 90°C and shall be material flame-retarded per IEEE 383 “Vertical Tray Flame Test”. Motor connection kits shall consist of heat-shrinkable, polymeric insulating material over the connection area and a high dielectric strength mastic to seal the ends against ingress of moisture and contamination. Motor connection kits shall accommodate a range of cable sizes for bot h in-line and stub-type configurations. Connection kits shall be independent of cable manufacturer’s tolerances.

D. Wire Nut Connectors:

1. Wire nuts install in wet locations, exterior, etc., shall be self-contained, waterproof and corrosion-proof units incorporating prefilled silicone grease to block out moisture and air.
2. Connectors shall be UL listed appropriately sized according to manufacturer’s recommendation for the suitable wire sizes and voltage rating (600 volt minimum).
3. Connectors body shall have a color-coded outer shell.
4. Connectors shall be as manufactured by King Technology or approved equal.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Refer to Fire Alarm specifications for wiring specifications.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type RHW/XHHW, single conductors in raceway.

E. Conduit in crawl space shall be rigid galvanized steel.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway. Branch circuits shall not be permitted to be concealed in concrete, below slabs-on-grade or underground unless specifically noted on drawings.

H. Type MC Tuff Luminary Cable may be used in short length (6 foot maximum) for final connections to lighting fixtures with 0-10v control, no daisy chaining allowed.

I. MC Cable can be used for fixture and motor whips not to exceed 6 foot in length. No daisy chaining of fixtures.

J. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway. Branch circuits shall not be permitted to be concealed in concrete, below slabs-on-grade or underground unless specifically noted on drawings.

K. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, and strain relief device at terminations to suit application.

L. Class 1 Control Circuits: Type THHN-THWN, in raceway.

M. Class 2 Control Circuits: Type THHN-THWN, in raceway.

N. Conductors shall be rated 75 deg C in wet locations and 90 deg C in dry locations.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values. Lubricant shall be water based, no Yellow 77.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. 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.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) 12 inches (300 mm) of slack.

D. Joint of #10 AWG and smaller shall be made with properly insulated solderless type pressure connectors. Where stranded conductors or multiple solid conductors are connected to terminals, solderless lugs manufactured by Thomas and Betts Company or equivalent shall be used.

E. Joints of #8 AWG and larger in power and lighting circuits shall be of the type indented into the conductor by means of a hand or hydraulic pressure tool. Connectors shall be Burndy “Hy-dent” “Thomas and Betts”, “St-Kon”, or equivalent. Connectors for control wiring shall be Burndy “Hy-Lug”, or equivalent.

F. All circuits for exterior electric work shall be #10 AWG (minimum) and contain an extra #10 AWG (minimum) copper ground conductor. All exterior wiring shall be installed in conduit as specified above, unless otherwise noted as larger on the Drawings.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing agency to perform field quality-control testing.

B. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements. Procedures: Perform each visual and mechanical inspection and electrical test state din NETA ATS Section 7.3.1. Certify compliance with test parameters.

C. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

D. Measure tightness of bolted connections and compare torque measurements with manufacturer’s recommended values.

E. Verify continuity of each branch circuit conductor.

F. Tests: Service Entrance Cables, Power & Lighting Distribution Feeders and Feeders to all major mechanical equipment at 60A and over (i.e., chillers, AHU’s, etc.).

1. Tests shall be performed with a 1000-volt megger, and conductors shall test free from short-circuits and grounds.
2. Conductors shall be tested phase-to-phase and phase-to-ground.
3. Furnish the instruments, materials, and labor required. Perform the tests in the presence of the Contracting Officer.
4. Test readings shall be recorded and delivered to Owner and Engineer in a report.
5. Copy of Test results shall be included in O&M Manuals.

G. Demonstration: Subsequent to wire and cable hook-ups, energize circuit and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
    a. Test wells.
    b. Ground rods.
    c. Ground rings.
    d. Grounding arrangements and connections for separately derived systems.
2. Instructions for periodic testing and inspection of grounding features at test wells ground rings grounding connections for separately derived systems based on NETA MTS NFPA 70B.
    a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
    b. Include recommended testing intervals.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 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. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. Harger Lightning & Grounding.
7. ILSCO.
8. O-Z/Gedney; a brand of Emerson Industrial Automation.
9. Robbins Lightning, Inc.
10. SIEMENS Industry, Inc.; Energy Management Division.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

J. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.

K. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

L. Straps: Solid copper, copper lugs. Rated for 600 A.

M. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal one two-piece clamp.

N. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

O. Water Pipe Clamps:

1. Mechanical type, two pieces with stainless-steel bolts.
    a. Material: Die-cast zinc alloy.
    b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet (19 mm by 3 m).

B. Ground Plates: 1/4 inch (6 mm) thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 4/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.

C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-24-inch (6-by-50-by-600-mm) grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.6 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
3. Substations and Pad-Mounted Equipment: 5 ohms.
4. Manhole Grounds: 10 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, and coordinated with each other, using input from installers of the items involved:

B. Seismic Qualification Certificates: For hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.

C. Welding certificates.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide slotted metal angle and U-channel systems by one of the following:

a. Thomas & Betts Corporation.
b. Alstrut.
c. Unistrut; Diversified Products
d. Power-Strut.

2. Manufacturers: Subject to compliance with requirements, provide conduit sealing bushings and accessories by one of the following:

a. Bridgeport Fittings
b. GS Metals, Corporation
c. O-Z / Gedney

d. Raco, Inc.

3. Material: Pre-galvanized steel.
4. Channel Width: 1-1/4 inches (31.75 mm).
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
9. Channel Dimensions: Selected for applicable load criteria.

B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

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) Cooper B-Line, Inc.; a division of Cooper Industries.
2) Empire Tool and Manufacturing Co., Inc.
3) Hilti Inc.
4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
5) MKT Fastening, LLC.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.
7. Powder actuated fasteners and drive pin type fasteners are not acceptable.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.

B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

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).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

B. Touch Up: Clean welds and abraded areas of shop paint. Paint exposed areas after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA1.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 260543 "Underground Ductbanks" for exterior ductbanks, manholes, and underground utility construction.
2. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
3. Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.2 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.
10. Steel City.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. FMC: Comply with UL 1; zinc-coated steel.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:
    a. Material: Steel.
    b. Type: Set screw fittings.
3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

K. Joint Compound for IMC, GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

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. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group.
6. Condux International, Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

G. Fittings for LFNC: Comply with UL 514B.

2.3 BOXES, ENCLOSURES, AND CABINETS

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. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

1. Material: Cast metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, round.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

L. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep) 4 inches by 2-1/8 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep).

M. Gangable boxes are allowed.

N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

O. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

C. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. CDR Systems Corporation.
d. NewBasis.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC.".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. Christy Concrete Products.
d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC." “Telephone”.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Underground Conduit: RNC, Type EPC-40-PVC direct buried unless otherwise noted.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X, Stainless Steel.

B. Indoors: Apply raceway products as specified below unless otherwise indicated.

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC Raceway locations include the following:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. Boiler rooms.
    e. Crawl space

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Aluminum conduit is prohibited.

E. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use set screw type, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

F. Do not install aluminum boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. 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.

C. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.

D. Arrange stub-ups so curved portions of bends are not visible above finished slab.

E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

F. Conceal conduit and EMT within finished walls and ceilings unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

G. Support conduit within 12 inches ((300 mm)) of enclosures to which attached.

H. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from RNC, Type EPC-40-PVC to GRC before rising above floor, including 90 degree sweep elbow, into wall cavity.
6. Feeders only under slab. There are to be no branch circuits in or under slab unless specifically noted on the drawings.
7. No conduits shall be routed in crawl space unless specifically noted on drawings.

I. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35-mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

N. 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 slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

O. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
2. Secure surface raceway with two hole straps at intervals not exceeding 32 inches (813-mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

P. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with 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.

Q. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

R. Expansion-Deflection Fittings: Provide an expansion/deflection fitting in each concealed or exposed electrical run crossing a building expansion joint. Fittings shall be complete with bronze end couplings, neoprene sleeve, tinned copper braid integral bonding jumper and stainless steel bands. Expansion/deflection fittings shall be suitable for the size and type of conduit run they connect. Bonding jumper shall comply with NEC and UL requirements.

1. Expansion/deflection fitting shall accommodate the following movements without collapsing or fracturing the conduit and damaging the wires it contains:
   a. Axial expansion or contraction up to 3/4-inch.
   b. Angular misalignment of the axes of the conduits up to 30 degrees in all directions.
   c. Parallel misalignment of the axes of the conduits up to 3/4-inch in all directions.
2. Expansion/Deflection fitting shall be OZ/Gedney Type DX or approved equal by Crouse Hinds (Type XD).

S. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

T. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.

U. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.

V. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

W. Locate boxes so that cover or plate will not span different building finishes.

X. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

Z. Set metal floor boxes level and flush with finished floor surface.

AA. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured duct elbows for stub-up at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below frost line below grade.

E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

F. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

G. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

H. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.
2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 7 Section "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.8 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding."

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.10 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 26 05 33

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
   b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by the following provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Advance Products & Systems, Inc.
   b. CALPICO, Inc.
   c. Metraflex Company (The).
   d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. HOLDRITE.

2.4 GROUT

A. Description: Nonshrink; recommended 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 (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: 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 FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 3 inches (76.2 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

H. Separate sleeve required for each different type of low voltage system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 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. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION 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. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E and Section 260574 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. 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 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

1. Color shall be factory applied.
2. Colors for 208/120-V Circuits:
    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.
    d. Neutral: White.
3. Colors for 480/277-V Circuits:
    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.
    d. Neutral: Gray.
4. Color for Equipment Grounds: Green.
5. Colors for Isolated Grounds: Green with white stripe.

C. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.3 LABELS

A. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameter and that stay in place by gripping action.

1. Manufacturers:
    a. Brady Corporation.
    b. Hellermann Tyton.
    c. Marking Services, Inc.
    d. Panduit Corp.

e. Seton Identification Products.

B. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil (0.08 mm) thick, multicolor, weather and UV resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers:

a. Brady Corporation.
b. Hellermann Tyton.
c. Marking Services, Inc.
d. Panduit Corp.
e. Seton Identification Products.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameter and that stay in place by gripping action.

1. Manufacturers:

a. Brady Corporation.
b. Hellermann Tyton.
c. Marking Services, Inc.
d. Panduit Corp.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

1. Manufacturers:

a. Carlton Industries, LP
b. Champion America
c. Hellermann Tyton
d. Ideal Industries, Inc.
e. Marking Services, Inc.
f. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.

1. Manufacturers:

a. Brady Corporation.
b. Carlton Industries, LP
c. Emedeo
d. Marking Services, Inc.

C. Floor Marking Tape: 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

1. Manufacturers:

a. Carlton Industries, LP

b. Seton Identification Products.

D. Detectable Underground-Line Warning Tape:

1. Manufacturers:

a. Brady Corporation.
b. Ideal Industries, Inc.
c. LEM Products, Inc.
d. Marking Services, Inc.
e. Reef Industries, Inc.
f. Seton Identification Products.

2. Tape:

a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
b. Printing on tape shall be permanent and shall not be damaged by burial operations.
c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

3. Color and Printing:

a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.6 SIGNS

A. Baked-Enamel Signs:

1. Manufacturers:

a. Carlton Industries, LP
b. Champion America
c. Emedco
d. Marking Services, Inc.

2. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4-inch (6.4-mm) grommets in corners for mounting.
4. Nominal Size: 7 by 10 inches (180 by 250 mm).

B. Metal-Backed Butyrate Signs:

1. Manufacturers:

a. Carlton Industries, LP
b. Champion America
c. Emedco
d. Marking Services, Inc.

2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch (1-mm) galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
3. 1/4-inch (6.4-mm) grommets in corners for mounting.
4. Nominal Size: 10 by 14 inches (250 by 360 mm).

C. Laminated Acrylic or Melamine Plastic Signs:

1. Manufacturers:

a. Carlton Industries, LP
b. Champion America
c. Emedco
d. Marking Services, Inc.

2. Engraved legend.
3. Thickness:

a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick).
b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
c. Engraved legend with white letters on a black background.
d. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 CABLE TIES

1. Manufacturers:

a. Hellerman Tyton
b. Ideal Industries, Inc.
c. Marking Services, Inc.
d. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

H. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

I. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

J. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer, emergency power.

L. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

M. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Labels:

1. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

Q. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

R. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

S. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

T. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

U. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

V. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

W. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

X. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 20 A and 120 V to Ground: Identify with snap-around labels applied in bands.

1. Locate identification label at 10 foot (3-m) maximum intervals.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. “Security System” – blue and yellow.
2. “Power” – orange.
3. "Emergency Power” – yellow.
4. “Control Wiring” – green and red.
5. “Mechanical & Electrical Supervisory System” – green and blue.
6. “Fire Alarm System” – red.
7. “Telecommunication System” – green and yellow.

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive wraparound labels with the conductor designation.

H. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

I. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

J. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

K. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

    a. Power-transfer switches.
    b. Controls with external control power connections.

M. Arc Flash Warning Labeling: Self-adhesive labels.

N. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.

O. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer and emergency power.

P. Equipment Identification Labels:

1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
2. Outdoor Equipment: Laminated acrylic or melamine sign.
3. Equipment to be labeled (all may not apply to this project):

    a. Panelboards, electrical cabinets, and enclosures.
    b. Access doors and panels for concealed electrical items.
    c. Electrical switchgear and switchboards.
    d. Transformers.

e. Electrical substations.
f. Emergency system boxes and enclosures.
g. Motor-control centers.
h. Disconnect switches.
i. Enclosed circuit breakers.
j. Motor starters
k. Push-button stations.
l. Power transfer equipment.
m. Contactors.
n. Remote-controlled switches, dimmer modules, and control devices.
o. Battery inverter units.
p. Battery racks.
q. Power-generating units.
r. Voice and data cable terminal equipment.
s. Master clock and program equipment.
t. Time clocks
u. Intercommunication and call system master and staff stations.
v. Television/audio components, racks, and controls.
w. Fire-alarm control panel and annunciators.
x. Security and intrusion-detection control stations, control panels, terminal cabinets and racks.
y. Monitoring and control equipment.
z. Uninterruptible power supply equipment.
aa. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
bb. Dimmers.
cc. Transformers.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Photoelectric switches.
2. Standalone daylight-harvesting switching and dimming controls.
3. Indoor occupancy and vacancy sensors.
4. Switchbox-mounted vacancy sensors
5. Lighting contactors.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show installation details for the following:
   a. Occupancy sensors.
   b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.
4. Floor plans with all sensor locations and associated coverage patterns. Sensor layouts displayed on drawings are product specific to basis of design. Alternative manufacturers submitting on project are allowed to submit their own sensor layout for review and approval based on their specific coverage patterns. Quantities may vary from manufacturer to manufacturer.

1.3 ALTERNATE MANUFACTURERS:

A. Refer to specification section 26 51 19 – 1.3 – C.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Field quality-control reports.

C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Software and firmware operational documentation.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: Two (2) years from date of Substantial Completion.

1.7 ADDITIONAL MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Occupancy and Vacancy Sensors – Ceiling mounted: Provide 5 additional units with associated power pack with same type and ratings.
2. Vacancy Sensor Switch Combination: Provide 2 additional units with same type and ratings.
3. Vacancy Sensor Switch Combination – Dual Relay: Provide 1 additional unit with same type and ratings.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY AND VACANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Steinel/Crestron.
2. Alternate manufacturers require county approval prior to bid date.

B. General Requirements for Sensors:

1. Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
2. Passive infrared Ultrasonic Dual technology.
3. Separate power pack.
4. Hardwired connection to switch in stand-alone rooms.
5. Low voltage connections via networked lighting control panels.
6. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
7. Operation:

a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.

b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.

8. Sensor Output: Sensor is powered from the power pack.
9. Power Pack: Dry contacts rated for 20-A ballast LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
10. Power Failure memory:

a. Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and parameters saved in protected memory shall not be lost.
b. Designed and tested to withstand discharges without impairment of performance when subjected to dischargers of 15,000 volts per IEC 801-2.

11. Mounting:

a. Sensor: Suitable for mounting in any position on a standard outlet box.
b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

12. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
13. Bypass Switch: Override the "on" function in case of sensor failure.
14. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
15. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.

C. PIR Type: Wall or Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
2. Detection Coverage (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 2000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
4. Extreme Temperature PIR types shall have operating temperatures from -40deg F to 125d F. UL Listed for damp locations. Temperature compensating circuitry to avoid false activation in extreme conditions, segmented frosted lens, Immune to RFI, EMI and voltage fluctuations.

D. Ultrasonic Type: Wall or Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).

2. Utilize Doppler shift ultrasonic detection technology.
3. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
4. Detection Coverage (Corridor): Detect occupancy anywhere within 80 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).
5. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 2000 square feet (220 square meters) when mounted84 inches (2100 mm) above finished floor.

E. Dual-Technology Type: Wall of Ceiling mounted; detect occupants in coverage area using PIR and Ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
4. Incorporate Doppler shift ultrasonic and passive infrared motion detection technologies. Products that react to noise or ambient sound shall not be considered.

F. Vacancy Wall Switch/Dimmer Combinations:

1. Requires manual On to activate lighting.
2. Provide a mechanical air-gap on/off function for all sensors.
3. Capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.
4. Shall accommodate loads from 0-800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180 degree coverage capability.
5. Shall be able to have their visible plastic parts replaced, for color changes in the field, without removing the body of the control from the wall and without requiring special tools.
6. Shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.
7. Shall be dual technology.
8. A Neutral shall be required.
9. Where specified as dual relay, provide two separate buttons, one for lighting, one for motor load. Each relay can be set independently to automatic or manual on mode. Motor load relay rated for 1/4hp minimum. Motor load relay shall have adjustable time delay for 10 minutes minimum after no detection.
10. Shall have adjustable time delay.
11. Shall have self-adaptive technology.

2.2 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company.

B. Description: Electrically operated and mechanically electrically held, combination-type lighting contactors with fusible switch non-fused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings matching the NEMA type specified for the enclosure.

2.3 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

C. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies and per shop drawings.

D. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

E. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 3/4 inch (21-mm).

B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within twenty-four (24) months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to four (4) visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Submit written documentation of completion.

3.6 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial

Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Provide 8 hours of training.

END OF SECTION

SECTION 260926 - LIGHTING CONTROL PANELS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Distributed Digital Lighting Control System, including:

1. Digital Lighting
2. Relay Panels
3. Emergency Lighting Control

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.
2. Section 260923 “Lighting Control Devices” for occupancy/vacancy sensors used in conjunction with the lighting control system.

1.2 REFERENCES

1. NFPA 70 – National Electrical Code; National Fire Protection Association
2. NEMA – National Electrical Manufacturers Association
3. FCC Emissions Standards
4. UL – Underwriters Laboratories, Inc.
5. UL 2043 – Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products Installed in Air-Handling Spaces.
6. UL 20 – General Use Switches, Plug Load Controls

1.3 DESIGN/PERFORMANCE REQUIRMENTS

A. Digital Lighting Management System shall accommodate the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories that suit the required lighting and electrical system parameters.

B. System shall conform to requirements of NFPA 70.

C. System shall comply with FCC emission standards specified in part 15, sub-part J for commercial and residential application.

D. System shall be listed under UL sections 916 and/or 508.

1.4 ALTERNATE MANUFACTURERS:

A. Refer to specification section 26 51 19 – 1.3 – C.

1.5 ACTION SUBMITTALS

A. Product Data: Manufacturer’s data sheets on each product to be used, including:

1. Catalog sheets and specifications
2. Ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
3. Storage and handling requirements and recommendations
4. Installation instructions.

B. Shop Drawings: Wiring diagrams for the various components of the System specified including:

1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
2. Show location of all devices, including at minimum sensors, load controllers, and switches/dimmers for each area of reflected ceiling plans.
3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.

C. Manufacturer’s Certificates: Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual installed locations and settings for lighting control devices.

B. Operation and Maintenance Manual:

1. Include approved Shop Drawings and Product Data.
2. Include Sequence of Operation, identifying operation for each room or space.
3. Include manufacturer’s maintenance information.
4. Operation and Maintenance Data: Include detailed information on device programming and setup.
5. Include startup and test reports.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing of centralized and distributed lighting control systems with a minimum of 10 years documented experience.

B. Installer Qualifications: Company certified by the manufacturer and specializing in installation of lighting control products with minimum three years documented experience.

C. System Components: Demonstrate that individual components have undergone quality control and testing prior to shipping.

1.8 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to commencing Work of this section. Meeting to be attended by Contractor, Architect, Lighting Designer/Engineer, System installer, Factory authorized manufacturer's representative, and representative of all trades related to the system installation.

B. Review installation procedures and coordination required with related Work and the following:

1. Confirm the location and mounting of all devices, with special attention to placement of switches, dimmers, and any sensors.
2. Review the specifications for low voltage control wiring and termination.
3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
4. Discuss requirements for integration with other trades

C. Inspect and make notes of job conditions prior to installation:

1. Record minutes of the conference and provide copies to all parties present.
2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
3. Installation shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store products in a clean, dry space in original manufacturer’s packaging in accordance with manufacturer’s written instructions until ready for installation.

1.10 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.

B. Do not install equipment until following conditions can be maintained in spaces to receive equipment:

1. Ambient temperature: 32 to 104 degrees F (0 to 40 degrees C).
2. Relative humidity: Maximum 90 percent, non-condensing.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer shall provide a 5-year limited warranty on products within this installation, except where otherwise noted, and consisting of a one-for-one device replacement

1.12 ADDITIONAL MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Room Controllers (classrooms) – Provide 1 single zone unit..
2. Low Voltage Engraved Control Stations – Provide 2, engraved as per installed on project.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Steinel/Crestron:

1. Alternate manufacturers require county approval prior to bid date.

2.2 DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

A. Equipment required: Lighting Control and Automation system as defined under this section covers the following equipment.

1. Digital Lighting Management (DLM) local network: Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
2. Digital Occupancy Sensors: Self-configuring, digitally addressable, calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
3. Digital Switches: Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications.
4. Handheld remotes for personal control: On/Off, dimming and scene remotes for control using infrared (IR) communications. Remote may be configured in the field to control selected loads or scenes without special tools.
5. Digital Daylighting Sensors: Single-zone open loop daylighting sensors with two-way active infrared (IR) communications for daylight harvesting using switching, bi-level, tri-level or dimming control.
6. Digital Lighting Management Relay Panel and Zone Controller: Provides up to 8, 24, or 48 mechanically latching relays. Relays include a manual override and a single push-on connector for easy installation or removal from the panel. Panel accepts program changes from handheld configuration tool for date and time, location, holidays, event scheduling, button binding and group programming.
7. Emergency Lighting Control Unit (ELCU): Allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.

B. Local Network LMRJ-Series: DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building.
1. Features of the DLM local network include:

a. Plug n' Go automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
b. Simple replacement of any device in the local DLM network with a standard off the shelf unit without requiring significant commissioning, configuration or setup.
c. Push n' Learn configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.
d. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.

2. Digital room devices connect to the local network using pre-terminated Cat 5e cables with RJ-45 connectors, which provide both data and power to room devices. Systems that utilize RJ-45 patch cords but do not provide serial communication data from individual end devices are not acceptable.

3. If manufacturer's pre-terminated Cat5e cables are not used for the installation each cable must be individually tested and observed by authorized service representative following installation.

2.3 DIGITAL LOAD CONTROLLERS (ROOM CONTROLLERS)

A. Digital Load Controllers: Digital controllers for lighting zones, fixtures and/or plug loads automatically bind room loads to the connected control devices in the space without commissioning or the use of any tools. Provide controllers to match the room lighting and plug load control requirements. Controllers are simple to install, and do not have dip switches/potentiometers, or require special configuration for standard Plug n' Go applications. Control units include the following features:

1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room
2. Simple replacement using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf device.
3. Multiple room controllers connection together in a local network must automatically arbitrate with each other, without requiring any configuration or setup, so that individual load numbers are assigned starting with load 1 to a maximum of 64, assigned based on each controller's device ID's from highest to lowest.
4. Device Status LEDs to indicate:

    a. Data transmission.
    b. Device has power.
    c. Status for each load.
    d. Configuration status.

5. Quick installation features including

    a. Standard junction box mounting.
    b. Quick low-voltage connection using standard RJ-45 patch cable.

6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power.

    a. Turn on to 100 percent.
    b. Turn off.
    c. Turn on to last level.

7. Each load shall be configurable to operate in the following sequences based on occupancy:

    a. Auto-On/Auto-Off (Follow on and off)
    b. Manual-On/Auto-Off (Follow off only)

8. Polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.
9. UL 2043 plenum rated.
10. Manual override and LED indication for each load.
11. Zero cross circuitry for each load.
12. All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
13. Dimming Room Controllers shall share the following features:

a. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
b. The following dimming attributes may be changed or selected using a wireless configuration tool:

    1) Establish preset level for each load from 0-100 percent.
    2) Set high and low trim for each load.

c. Override button for each load provides the following functions:

    1) Press and release for on/off control.
    2) Press and hold for dimming control.

d. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected driver. LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
e. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100 percent dimming range defined by the minimum and maximum calibration trim.
f. Calibration and trim levels must be set per output channel. Devices that set calibration or trim levels per controller (as opposed to per load) are not acceptable.
g. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.

2.4 DIGITAL DAYLIGHTING SENSORS

A. Digital daylighting sensors shall work with load controllers and relay panels to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to the controller or panel. Daylighting sensors shall be interchangeable without the need for rewiring.

1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.
2. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.
3. Dual loop sensors measure both ambient and incoming daylight in the space to insure that proper light levels are maintained as changes to reflective materials are made in a single zone

B. Digital daylighting sensors shall include the following features:

1. Senor’s internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. Photodiode shall not measure energy in either the ultraviolet or infrared spectrums. Photocell shall have a sensitivity of less than 5 percent for any wavelengths less than 400 nanometers or greater than 700 nanometers.
2. Sensor light level range shall be from 1-6,553 foot-candles (fc).
3. Capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of load controller(s) and load binding to controller(s).
4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.

5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.
6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.
8. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
9. Configuration LED status light on device that blinks to indicate data transmission.
10. Status LED indicates test mode, override mode and load binding.
11. Recessed switch on device to turn controlled load(s) ON and OFF.
12. BACnet object information shall be available for the following daylighting sensor objects, based on the specific photocell's settings:

    a. Light level
    b. Day and night setpoints
    c. Off time delay
    d. On and off setpoints
    e. Up to three zone setpoints
    f. Operating mode - on/off, bi-level, tri-level or dimming

13. One RJ-45 port for connection to DLM local network.
14. A choice of accessories to accommodate multiple mounting methods and building materials. Photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors accommodate mounting materials from 0-0.62 inch thick (LMLS-400, LMLS-500). Extended tube photosensors accommodate mounting materials from 0.62 to 1.25 inches thick (LMLS-400-L, LMLS-500-L). Mounting brackets are compatible with J boxes (LMLS-MB1) and wall mounting (LMLS-MB2). LMLS-600 photosensor to be mounted on included bracket below skylight well.
15. Any load or group of loads in the room can be assigned to a daylighting zone
16. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
17. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.

2.5 LMCP LIGHTING CONTROL PANELS AND LMZC ZONE CONTROLLER

A. Hardware: Provide LMCP lighting control panels in the locations and capacities as indicated on the Drawing and schedules. Each panel shall be of modular construction and consist of the following components:

1. Enclosure/Tub shall be NEMA 1, sized to accept an interior with 1 - 8 relays, 1 - 24 relays and 6 four-pole contactors, or 1 - 48 relays and 6 four-pole contactors.
2. Cover shall be configured for surface or flush wall mounting of the panel as indicated on the plans. LMCP panel cover shall have a hinged and lockable door with restricted access to line voltage section of the panel.
3. Interior assembly shall be supplied as a factory assembled component specifically designed and listed for field installation. Interior construction shall provide total isolation of high voltage (Class 1) wiring from low voltage (Class 2) wiring within the assembled panel. Interior assembly shall include intelligence boards, power supply, DIN rails for

mounting optional Class 2 control devices, and individually replaceable latching type relays. Panel interiors shall include the following features:

a. Removeable, plug-in terminal blocks with connections for all low voltage terminations.
b. Individual terminal block, override pushbutton, and LED status light for each relay.
c. Direct wired switch inputs associated with each relay shall support 2-wire momentary switches only.
d. Digital inputs (four RJ-45 jacks) shall support 1-, 2-, 3-, 4-, and 8-button digital switches; digital IO modules capable of receiving 0-5V or 0-10V analog photocell inputs; digital IO modules capable of receiving momentary or maintained contact closure inputs or analog sensor inputs; digital daylighting sensors; and digital occupancy sensors. Inputs are divided into two separate digital networks, each capable of supplying 250mA to connected devices.
e. True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems via BACnet.
f. Automatically sequenced operation of relays to reduce impact on the electrical distribution system when large loads are controlled simultaneously.
g. Group and pattern control of relays shall be provided through a simple keypad interface from a handheld IR programmer. Any set of relays can be associated with a group for direct on/off control or pattern (scene) control via a simple programming sequence using the relay override pushbuttons and LED displays for groups 1-8 or a handheld IR programmer for groups 1-99.
h. Relay group status for shall be provided through LED indicators for groups 1-8 and via BACnet for groups 1-99. A solid LED indicates that the last group action called for an ON state and relays in the group are on or in a mixed state.

4. Single-pole latching relays with modular plug-in design. Relays shall provide the following ratings and features:

   a. Electrical:

      1) 30 amp ballast at 277V
      2) 20amp tungsten at 120V
      3) 1.5 HP motor at 120V
      4) 14,000 amp short circuit current rating (SCCR) at 347V

   b. Mechanical:

      1) 30 amp ballast at 277V
      2) 20amp tungsten at 120V
      3) 1.5 HP motor at 120V
      4) 14,000 amp short circuit current rating (SCCR) at 347V

5. Isolated low voltage contacts provide for true relay status feedback and pilot light indication.
6. Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.
7. Where indicated, lighting control panels designated for control of emergency lighting shall be provided with factory installed provision for automatic by pass of relays controlling emergency circuits upon loss of normal power. Panels shall be properly listed and labeled for use on emergency lighting circuits and shall meet the requirements of UL924 and NFPA 70 - Article 700. All emergency fixtures being dimmed under normal power shall go to full brightness.

8. Integral system clock shall provide scheduling capabilities for panel-only projects without DLM segment networks or BAS control.

    a. Each panel shall include digital clock capability able to issue system wide automation commands to up to 11 other panels for a total of 12 networked lighting control panels. Clock shall provide capability for up to 254 independent schedule events per panel for each of the ninety-nine system wide channel groups.
    b. Clock capability of each panel shall support the time-based energy saving requirements of applicable local energy codes.
    c. Clock module shall provide astronomic capabilities, time delays, blink warning, daylight savings, and holiday functions and will include a battery back up for clock function and program retention in non-volatile FLASH memory. Clocks that require multiple events to meet local code lighting shut off requirements shall not be allowed.
    d. Clock capability of each panel shall operate on a basis of ON/OFF or Normal Hours/After Hours messages to automation groups that implement pre-configured control scenarios. Scenarios shall include:

        1) Scheduled ON / OFF
        2) Manual ON / Scheduled OFF
        3) Astro ON / OFF (or Photo ON / OFF)
        4) Astro and Schedule ON / OFF (or Photo and Schedule ON / OFF)

    e. User interface shall be portable IR handheld remote control capable of programming any panel in the system
    f. Clock capability of each panel shall employ non-volatile memory and shall retain user programming and time for a minimum of 10 years.
    g. Schedules programmed into the clock of any one panel shall be capable of executing panel local schedule or Dark/Light (photocell or Astro) events for that panel in the event that global network communication is lost. Lighting control panels that are not capable of executing events independently of the global network shall not be acceptable.

9. Lighting control panel can operate as a stand-alone system, or can support schedule, group, and photocell control functions, as configured in a Segment Manager controller, via a segment network connection.
10. Lighting control panel shall support digital communications to facilitate the extension of control to include interoperation with building automation systems and other intelligent field devices. Digital communications shall be RS485 MS/TP-based using the BACnet protocol.

    a. Panel shall have provision for an individual BACnet device ID and shall support the full 222 range (0 - 4,193,304). The device ID description property shall be writable via the network to allow unique identification of the lighting control panel on the network.
    b. Panel shall support MS/TP MAC addresses in the range of 0 - 127 and baud rates of 9600k, 38400k, 76800k, and 115.2k bits per second.
    c. Lighting control relays shall be controllable as binary output objects in the instance range of 1 - 64. The state of each relay shall be readable and writable by the BAS via the object present value property.
    d. Lighting control relays shall report their true on/off state as binary input objects in the instance range of 1 - 64.
    e. The 99 group Normal Hours/After Hours control objects associated with the panel shall be represented by binary value objects in the instance range of 201 - 299. The occupancy state of each channel group shall be readable and writable by the BAS via the object present value property. Commanding 1 to a channel group will

put all relays associated with the channel into the normal hours mode. Commanding 0 or NULL shall put the relays into the after hours mode.

f. Setup and commissioning of panel shall not require manufacturer-specific software or a computer. All configuration of the lighting control panel shall be performed using standard BACnet objects or via the handheld IR programming remote. Provide BACnet objects for panel setup and control as follows:
   1) Binary output objects in the instance range of 1 - 64 (one per relay) for on/off control of relays.
   2) Binary value objects in the instance range of 1 - 99 (one per channel) for normal hours/after hours schedule control.
   3) Binary input objects in the instance range of 1 - 64 (one per relay) for reading true on/off state of the relays.
   4) Analog value objects in the instance range of 101 - 199 (one per channel group) shall assign a blink warn time value to each channel. A value of 5 shall activate the blink warn feature for the channel and set a 5-minute grace-time period. A value of 250 shall activate the sweep feature for the channel and enable the use of sweep type automatic wall switches.

11. In addition to the LMCP Relay Panels, an LMZC Zone Controller panel shall be available for zero-relay applications. The panel is designed for applications where LMFC-011 Fixture Controllers or other distributed load controllers are used to switch and/or dim the controlled loads. Key similarities to and differences from the LMCP panel design shall include:

    a. Use the same intelligence board as the LMCP relay panel.
    b. Shall not include relay driver boards or relays.
    c. Have a removable interior section to facilitate installation, and a Tub/Cover. Cover is for surface mounting applications only.
    d. Tub shall have two interior KOs to allow installation of LMPB-100 Power Boosters. Each installed Power Booster can provide an additional 150 mA for either of the two available DLM local networks provided by the LMZC.
    e. All programming and networking (whether DLM Local Network and/or Segment Network) capabilities in the LMZC Zone Controller shall be similar to capabilities for LMCP relay panels, except for functions designed for panel-mounted HDR relays.

12. To aid in project start up, if LMFC Fixture Controllers are connected to an LMZC Zone Controller, Plug n' Go automatic configuration will establish a unique sequence of operation so that all LMFC-controlled fixtures will turn on to 50 percent output when any digital occupancy sensor detects motion.

B. User Interface: Each lighting control panel system shall be supplied with at least one handheld configuration tool. As a remote programming interface, the configuration tool shall allow setup, configuration, and diagnostics of the panel without the need for software or connection of a computer. User interface shall have the following panel-specific functions as a minimum:

1. Button binding of digital switches to groups shall be accessible via the handheld IR remote and accomplished from the digital switch station.
2. Programming of panel location information shall be accomplished by the handheld IR remote and include at a minimum LAT, LON, DST zone, and an approximate city/state location.

2.6 EMERGENCY LIGHTING CONTROL DEVICES

A. Emergency Lighting Control Unit - A UL 924 listed device that monitors a switched or dimmed circuit providing normal lighting to an area. The unit provides normal ON/OFF control of

emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:

1. 120/277 volts, 50/60 Hz, 20-amp ballast rating
2. Push to test button
3. Auxiliary contact for remote test or fire alarm system interface
4. Shall disconnect 0-10v control wiring turning light fixture to full brightness.

PART 3 EXECUTION

3.1 PREPARATION

A. Do not begin installation until measurements have been verified and work areas have been properly prepared.

B. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that required pre-installation meeting specified in Part 1 of this specification has been completed, recorded meeting minutes have been distributed and all outstanding issues noted have been resolved prior to the start of installation.

3.2 INSTALLATION

A. Install system in accordance with the approved system shop drawings and manufacturer's instructions.

B. Install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors.

1. If fixtures have internal DLM Control Modules, ensure that they are also connected with Cat 5e cable.
2. Low voltage wiring topology must comply with manufacturer's specifications.

C. All line voltage connections shall be tagged to indicate circuit and switched legs.

D. Test all devices to ensure proper communication.

E. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.

F. Provide written or computer-generated documentation on the configuration of the system including room by room description including:

1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
3. Load Parameters (e.g. blink warning, etc.)

G. Post start-up tuning - Adjust sensor time delays and sensitivities to meet the Owner's requirements 30 days from beneficial occupancy. Provide a detailed report to the Architect / Owner of post start-up activity.

H. Tighten all panel Class I conductors from both circuit breaker and to loads to torque ratings as marked on enclosure UL label.

I. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.

J. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads shall have separate neutral.

K. Verify all non-panel-based lighting loads to be free from short circuits prior to connection to room controllers.

3.3 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Notify Architect, Lighting Designer and Manufacturer in writing a minimum of 3 weeks prior to system start-up and testing.

B. Tests and Inspections: Manufacturer's service representative shall perform the following inspections and prepare reports.

1. Verify Class I and II wiring connections are terminated properly by validating system performance.
2. Set IP addresses and other network settings of system front end hardware per facilities IT instructions.
3. Verify / complete task programming for all switches, dimmers, time clocks, and sensors.
4. Verify that the control of each space complies with the Sequence of Operation.
5. Correct any system issues and retest.

C. Provide a report in table format with drawings, or using a software file that can be opened in the manufacturer's system software including each room or space that has lighting control installed. Indicate the following:

1. Date of test or inspection.
2. Loads per space, or Fixture Address identification.
3. Quantity and Type of each device installed
4. Reports providing each device's settings.

3.4 DEMONSTRATE AND TRAINING

A. Before Substantial Completion, arrange and provide two separate training session (min. of 4 hours each) for Owner instruction period to designated Owner personnel. Set-up, starting of the lighting control system and Owner instruction includes:

1. Confirmation of entire system operation and communication to each device.
2. Confirmation of operation of individual relays, switches, and sensors.
3. Confirmation of system Programming, photocell settings, override settings, etc.
4. Provide training to cover installation, programming, operation, and troubleshooting of the lighting control system.

3.5 PRODUCT SUPPORT AND SERVICE

A. Factory telephone support shall be available at no cost to the Owner following acceptance. Factory assistance shall consist of assistance in solving application issues pertaining to the control equipment.

END OF SECTION

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

B. SPD: Surge protective device.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Include evidence of NRTL listing for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 INFORMATIONAL SUBMITTALS

A. Panelboard schedules for installation in panelboards.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 FIELD CONDITIONS

A. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

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. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Flush and Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 4X, stainless steel.
c. Kitchen Areas: NEMA 250, Type 4X stainless steel.
d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4X, stainless steel.
e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Height: 84 inches (2.13 m) maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box with continuous piano hinge and with standard door within hinged trim cover with continuous piano hinge. Trims shall cover all live parts and shall have no exposed hardware.
5. Finishes:

a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Same finish as panels and trim.

F. Incoming Mains Location: Top and Bottom.

G. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Compression type, with a lug on the neutral bar for each pole in the panelboard.
3. Ground Lugs and Bus-Configured Terminators: Compression type, with a lug on the bar for each pole in the panelboard.
4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
6. Exact Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

I. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

J. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

B. Surge Suppression: See Specification 264313: Surge Protection for Low Voltage Power Circuits, Section 2.3, Panel Suppressors.

2.3 POWER PANELBOARDS

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D.
2. General Electric Company
3. Siemens Power Transmission & Distribution, Inc.
4. Eaton.

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: Circuit breaker.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D.
2. General Electric Company
3. Siemens Power Transmission & Distribution, Inc.
4. Eaton.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only, as indicated.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Column-Type Panelboards: Single row of overcurrent devices with narrow gutter extension and overhead junction box equipped with ground and neutral terminal buses.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D.
2. General Electric Company
3. Siemens Power Transmission & Distribution, Inc.
4. Eaton.

B. Coordinate "MCCB" and "Fused Switch" paragraphs below with Drawings. See the "Circuit Breakers" Article in the Evaluations for guidance on making selections.

C. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.
b. Instantaneous magnetic trip element for short circuits.
c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:
    a. RMS sensing.
    b. Field-replaceable rating plug or electronic trip.
    c. Digital display of settings, trip targets, and indicated metering displays.
    d. Multi-button keypad to access programmable functions and monitored data.
    e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    f. Integral test jack for connection to portable test set or laptop computer.
    g. Field-Adjustable Settings:
        1) Instantaneous trip.
        2) Long- and short-time pickup levels.
        3) Long and short time adjustments.
        4) Ground-fault pickup level, time delay, and I squared T response.
4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
6. Subfeed Circuit Breakers: Vertically mounted.
7. MCCB Features and Accessories:
    a. Standard frame sizes, trip ratings, and number of poles.
    b. Breaker handle indicates tripped status.
    c. UL listed for reverse connection without restrictive line or load ratings.
    d. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
    e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    h. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
    i. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.6 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.

2.7 ACCESSORY COMPONENTS AND FEATURES

A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install panelboards and accessories according to NEMA PB 1.1.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

E. Mount panelboard cabinet plumb and rigid without distortion of box.

F. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

G. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

H. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

I. Install filler plates in unused spaces.

J. Stub four 1-inch (27-EMT) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-EMT) empty conduits into raised floor space or below slab not on grade.

K. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 24 16

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Straight-blade convenience receptacles.
2. USB charger devices.
3. GFCI receptacles.
4. Toggle switches.
5. Wall switch sensor light switches with dual technology sensors.
6. Wall-box dimmers.
7. Wall plates.

1.2 DEFINITIONS

A. Abbreviations of Manufacturers' Names:

1. Cooper: Copper Wiring Devices; Division of Cooper Industries, Inc.
2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
3. Leviton: Leviton Mfg. Company, Inc.
4. Pass & Seymour: Pass& Seymour/Legrand.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

D. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.

E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STRAIGHT-BLADE RECEPTACLES

A. Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Pass & Seymour; 5361 (single), 5362 (duplex).
2. Cooper.
3. Hubbell.
4. Leviton.

B. Tamper Resistant Convenience Receptacles, 125V, 20A: Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL498 and FS W-C-596

1. Pass & Seymour; TR5361 (single), TR5362 (duplex).
2. Cooper.
3. Hubbell.
4. Leviton.

C. Controlled Convenience Receptacles, 125V, 20A: Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL498 and FS W-C-596. Controlled receptacle marking permanently printed, molded or stamped on the face of the receptacle and in compliance with Controlled Receptacle marking requirements stated in Article 406.3(E) of the 2014 National Electrical Code

1. Pass & Seymour; 26352CD.
2. Cooper.
3. Hubbell.
4. Leviton.

D. Tamper-Resistant Controlled Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498 and Federal Specification W-C-596. Controlled receptacle marking permanently printed, molded, or stamped on the face of the receptacle and

in compliance with Controlled Receptacle Marking requirements stated in Article 406.3(E) of the 2014 National Electrical Code

1. Pass & Seymour; TR26352CD.
2. Cooper.
3. Hubbell.
4. Leviton.

E. Water Resistant Convenience Receptacles, 125V, 20A: Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL498 and FS W-C-596

1. Pass & Seymour; WR5362 (duplex).
2. Cooper.
3. Hubbell.
4. Leviton.

2.3 CLOCK RECEPTACLES

A. Clock Hanger Receptacle, NEMA 5-15R, 125 V, 15 A recessed specification grade with smooth wall plate: Comply with UL Standard UL498.

1. Pass & Seymour; S3713W.
2. Cooper.
3. Hubbell.
4. Leviton.

2.4 USB CHARGER DEVICES

A. Tamper-Resistant, USB Charger Receptacles, 125 V, 20 A and a minimum charging output of 3.1 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, UL 1310, and FS W-C-596.

1. Pass & Seymour; TR5362USB (duplex).
2. Cooper.
3. Hubbell.
4. Leviton.

2.5 GFCI RECEPTACLES

A. General Description: Straight blade, non-feed-through-type. Comply with NEMA WD 1, MENA WD 6, UL 498, Federal Specification W-C-596, and UL943, Class A. Include indicator light that is lighted when device is tripped. Must have Self-test feature (conducts and automatic test every three seconds, ensuring ground fault protection. If ground fault protection is compromised, power to the receptacle must be discontinued.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A. Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL 498, Federal Specification W-C-596 and UL 943, Class A, and include indicator light that is lighted when device is tripped. Conducts and automatic test every three seconds, ensuring ground fault protection. If protection is lost, power to the unit is disconnected and indicator light flashes indicating that the unit should be replaced.

1. Pass & Seymour; 2097 (duplex).

2. Cooper
3. Hubbell
4. Leviton.

C. Tamper-Resistant, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL 498, Federal Specification W-C-596 and UL943, Class A, and include indicator light that is lighted when device is tripped. Conducts an automatic test every three seconds, ensuring ground fault protection. If protection is lost, power to the unit is disconnected and indicator light flashes indicating that the unit should be replaced.

1. Pass & Seymour; 2097TR (duplex).
2. Cooper.
3. Hubbell.
4. Leviton.

2.6 LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125V, 20A: Comply with NEMA WD1, NEMA WD6 configuration L5-20R and UL498.

1. Pass & Seymour; L520R.
2. Cooper; L520R.
3. Hubbell; HBL2310.
4. Leviton; 2310

2.7 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle both connector; NEMA WD6 configurations L5-20P and L5-20R, heavy-duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provisions for attaching external grip.
   a. L520 Plug: Pass & Seymour L520P
   b. L520R Connector: Pass & Seymour L520C.

2.8 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-coper conductors, with Type SOW-A jacket; with green insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon bod and integral cable-clamping joints. Match cord and receptacle type for connection.

2.9 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider toggle switch; with single-pole or three-way switching. Comply with UL 1472.

C. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; 1200va rated, 0-10v dimming, rocker switch with slide dimmer, designed for LED power supplies, 3-way compatible, capable of consistent dimming with low end not greater than 10 percent of full brightness, flicker free. Leviton IP710-LF series or approved equals.

2.10 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel, or per Architect.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.11 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: Brown.
2. Wiring Devices Connected to Emergency Power System: Red; with “Emergency Power” engraved on wall plate.
3. Controlled Wiring Devices: Gray; with “Switched” engraved on wall plate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. GFCI Receptacles: Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.2 IDENTIFICATION

A. Comply with Specification section 260553 “Identification for Electrical Systems”.

1. Identify panelboard and circuit number from which served. Use engraved, hot or stamped machine printing with black-filled lettering and locate on face plate of receptacle.

3.3 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections :

1. Tests for Convenience Receptacles:

a. Line Voltage: Acceptable range is 105 to 132 V.
b. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
c. Ground Impedance: Values of up to 2 ohms are acceptable.
d. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
e. Using the test plug, verify that the device and its outlet box are securely mounted.
f. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

D. Wiring device will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:
    a. Control circuits.
    b. Panelboards.
    c. Switchboards.
    d. Enclosed controllers.
    e. Enclosed switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bussmann, an Eaton business.
2. Edison; a brand of Bussmann by Eaton.
3. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
2. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, fast acting , time delay.
3. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.

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. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Owner.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Control Circuits: Type CC.
2. Motor Branch Circuits: Type RK1.
3. Other Branch Circuits: Type RK1.
4. Feeders: Type J.

3.3 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Shunt trip switches.
4. Molded-case circuit breakers (MCCBs).
5. Molded-case switches.
6. Enclosures.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.3 FUSIBLE SWITCHES

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D.
2. General Electric Company
3. Siemens Power Transmission & Distribution, Inc.
4. Eaton.

B. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 600-V ac.
4. 1200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.

6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories (required per device):

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Service-Rated Switches: Labeled for use as service equipment.
5. Lugs: Compression type, suitable for number, size and conductor material.

D. Optional Accessories (as specified on drawings):

1. Auxiliary Contact Kit: One NO/NC (Form “C”) auxiliary. Contacts would reactivate blades open.
2. Accessory Control Power Voltage: Remote-mounted and powered; 120-VAC. Provide as required with auxiliary contact kit.

2.4 NONFUSIBLE SWITCHES

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D.
2. General Electric Company
3. Siemens Power Transmission & Distribution, Inc.
4. Eaton.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories (required per device):

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Service-Rated Switches: Labeled for use as service equipment.
4. Lugs: Compression type, suitable for number, size and conductor material.

D. Optional Accessories (as specified on drawings):

1. Auxiliary Contact Kit: One NO/NC (Form “C”) auxiliary. Contacts would reactivate blades open.
2. Accessory Control Power Voltage: Remote-mounted and powered; 120-VAC. Provide as required with auxiliary contact kit.

2.5 MOLDED-CASE CIRCUIT BREAKERS

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D.
2. General Electric Company
3. Siemens Power Transmission & Distribution, Inc.
4. Eaton.

B. Show pole quantities, voltage and ampere ratings, and features and accessories of MCCBs and switches on Drawings. See the Evaluations.

C. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

D. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

E. Standards: Comply with UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents.

F. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

G. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Long- and short-time pickup levels.
2. Long- and short-time time adjustments.
3. Ground-fault pickup level, time delay, and I-squared t response.

H. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
3. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1) a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel).

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts.

D. Enclosures designated as NEMA 250 Type 4, 4X stainless steel shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

PART 3 - EXECUTION

3.1 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 4X, stainless steel.
3. Kitchen Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4X, stainless steel.

3.2 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in fusible devices.

F. Comply with NFPA 70 and NECA 1.

G. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, grounding, and clearances.
c. Verify that the unit is clean.
d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
e. Verify that fuse sizes and types match the Specifications and Drawings.
f. Verify that each fuse has adequate mechanical support and contact integrity.
g. Inspect bolted electrical connections for high resistance using one of the two following methods:
1) Use a low-resistance ohmmeter.
a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
i. Verify correct phase barrier installation.
j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

D. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that the unit is clean.
e. Operate the circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance using one of the two following methods:
1) Use a low-resistance ohmmeter.
a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.
h. Perform adjustments for final protective device settings in accordance with the coordination study.

END OF SECTION 26 28 16

SECTION 26 29 13 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following enclosed controllers rated 600 V and less:

1. Full-voltage manual.
2. Full-voltage magnetic.
3. Multispeed.

1.2 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. N.O.: Normally open.

F. OCPD: Overcurrent protective device.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed controller.

B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.

1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.7 QUALITY ASSURANCE

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.

B. Comply with NFPA 70.

C. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Square D.
   b. Eaton.
   c. General Electric Company.
   d. Siemens Industry, Inc.

2. Configuration: Nonreversing.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
4. Surface mounting.
5. Pilot light.
6. Hand-Off-Automatic selector switch.

C. Magnetic Controllers: Full voltage, across the line, electrically held.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Square D.
    b. Eaton.
    c. General Electric Company.
    d. Siemens Industry, Inc.

2. Configuration: Nonreversing.
3. Contactor Coils: Pressure-encapsulated type.

    a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

6. Solid-State Overload Relay:

    a. Switch or dial selectable for motor running overload protection.
    b. Sensors in each phase.
    c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

7. External overload reset push button.

D. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        a. Square D.
        b. Eaton.
        c. General Electric Company.
        d. Siemens Industry, Inc.

    2. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
    3. Nonfusible Disconnecting Means:

        a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
        b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2.2 MULTISPEED MAGNETIC CONTROLLERS

A. General Requirements for Multispeed Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Multispeed Magnetic Controllers: Two speed, full voltage, across the line, electrically held.
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Square D.
b. Eaton.
c. General Electric Company.
d. Siemens Industry, Inc.

2. Configuration: Nonreversing; consequent pole or two winding.
3. Contactor Coils: Pressure-encapsulated type.

a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

4. Power Contacts: Totally enclosed, double break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.
6. Compelling relays shall ensure that motor will start only at low speed.
7. Decelerating timer relays shall ensure automatically timed deceleration through each speed.

8. Solid-State Overload Relay:

a. Switch or dial selectable for motor running overload protection.
b. Sensors in each phase.
c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

9. External overload reset push button.

C. Combination Multispeed Magnetic Controller: Factory-assembled combination of multispeed magnetic controller, OCPD, and disconnecting means.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Square D.
b. Eaton.
c. General Electric Company.
d. Siemens Industry, Inc.

2. Nonfusible Disconnecting Means:

a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

2.3 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 4X stainless steel.
3. Kitchen Wash-Down Areas: Type 4X, stainless steel.

4. Other Wet or Damp Indoor Locations: Type 4X, stainless steel.

2.4 ACCESSORIES

A. Push Buttons, Pilot Lights, and Selector Switches: NEMA ICS 5; heavy-duty type; factory installed in controller enclosure cover unless otherwise indicated.

1. Pilot Lights: LED type; red for “Power Available”, green for “Running”; push to test.

B. Control Relays: Auxiliary and adjustable time-delay relays.

C. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings. Provide ICM controls ICM450 or approved equal, locate in separate enclosure at equipment; match NEMA enclosure rating with starter/disconnect.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height, and with disconnect operating handles not higher than 79 inches (2006 mm) above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in each fusible-switch enclosed controller.

E. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."

F. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

G. Comply with NECA 1.

3.2 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved nameplate.

3. Label each enclosure-mounted control and pilot device.

3.3 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Set field-adjustable switches and overload-relay pickup and trip ranges.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 26 29 13

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 260926 "Lighting Control Panelboards" for panelboards used for lighting control.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, power supply/driver and housing.

H. Delivered Lumen: Measured light output exiting luminaire after all lensing reflector housing, etc.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, arranged by designation.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Factory drawings for each variation of recessed and suspended linear lighting systems including lengths that are integral to continuous run with emergency functions in them. Submit factory drawing indicating which room each run is intended for.
3. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Include diagrams for power, signal, and control wiring.

C. Alternate Manufacturers:

1. Provide one luminaire for each alternate manufacturer of product not listed in light fixture schedule. Sample luminaire shall be the specified color temperature, lumen output, correct size (i.e. 2x2 or 2x4), plug and cord installed on luminaire. Paint chip samples for non-standard colors shall be provided to Architect in size and quantity as required by Architect. Provision of sample does not imply approval of luminaire. All samples must be delivered (assembled and in working order) for inspection 10 working days prior to bid with 5 working days review period allocated to design team. Each sample shall have factory label with date of manufacturing and shall have been fabricated within 6 months of bid date.

2. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish named item, or its equal of manufacturer indicated in this specification and as on Light Fixture Schedule. Alternate Manufacturers (other than first named or indicated as the basis of design) shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of alternate manufacturers for review.

3. The suitability of named item only has been verified. Where more than one Manufacturer is named, only the first named Manufacturer has been verified as suitable. Manufacturers and items other than first named shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement and application.

4. For each alternate manufacturer proposed by the Contractor, the Contractor shall clearly identify all differences (i.e., paragraph-by-paragraph, performance differences, physical differences, etc.) from the specified item, changes in Contract cost, benefits to the Owner and a brief description why the substitution is being proposed.

D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved:

B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

C. Product Certificates: For each type of luminaire.

D. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

1.7 ADDITIONAL MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Drivers: Provide 1 additional driver for every 25 luminaires of each type and rating installed. Furnish at least one of each type.
2. Lamps: Provide 1 additional led board (or module) for every 25 luminaires of each type and rating installed. Furnish at least one of each type.
3. Flat Panel Style LED luminaires: Provide 1 complete fixture for every 20 luminaires of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE 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.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. Recessed Fixtures: Comply with NEMA LE 4.

E. CRI minimum of 80. CCT of 4000 Kelvin. unless otherwise noted on light fixture schedule.

F. Rated lamp life of 50,000 hours minimum at L70.

G. Dimmable from 100 percent to 10 percent of maximum light output minimum, flicker free and no cut outs (unless otherwise specifically noted in light fixture schedule for lower dimming range).

All dimming controls shall be coordinated and confirmed with each light fixture manufacturer dimming driver prior to rough-in and confirmation indicated at shop drawing level in writing.

H. Internal driver. Bottom and/or room accessible when located in hard ceilings. No remote drivers unless specifically called for in light fixture schedule. All remote driver locations shall be submitted to architect for review and final approval prior to rough-in. Reverify all remote driver distances from luminaire with manufacturer recommendations and adjust wire size as required for normal operation.

I. Nominal Operating Voltage: 120 V ac through 277 V ac (universal voltage) 12 V dc 24 V dc.

J. Housings:

1. Extruded-aluminum housing and heat sink.
2. Anodized powder-coat painted finishes. Finish per Architect.
3. All parts painted after fabrication (room side and ceiling side, entire fixture assembly).

K. All interior Light Fixtures shall be DLC or Energy Star listed unless specifically noted on Light Fixture Schedule. Provide screen shot and print out from DLC at shop drawing level for each luminaire.

L. Refer to all Light Fixture Schedule General Notes.

2.3 RECESSED TROFFERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mercury Lighting
2. Visioneering
3. LSI Industries
4. Metalumen.
5. Finelite.
6. Elite Lighting.
7. Or approved equals. Refer to 265119-1.3-C.

B. Minimum and/or Maximum lumens shall be per light fixture schedule.

C. With integral mounting provisions.

D. Bottom/Room side access.

E. 0 – 10V dimmable with isolated lead wires.

F. All parts and pieces painted after fabrication (room side and ceiling side, entire fixture assembly).

G. Spring loaded cam latch style for doors.

H. Volumetric style luminaires:

1. shall have their associated lens(es) extend from edge of housing to edge of housing with no gaps, visible hardware, visible sockets or led boards.

2. Side reflector(s) shall be smooth (no ribs, linear angles or prisms/beam modifiers, etc.) and flush to luminaire housing with no visible shadowing or gaps.

2.4 DOWNLIGHT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Gotham.
2. Spectrum Lighting.
3. Pathway Lighting.
4. Lum-Tech Lighting.
5. Or approved equals. Refer to 265119-1.3-C.

B. Minimum lumens shall be per light fixture schedule. Minimum allowable efficacy of 68 lumens per watt.

C. Universal mounting bracket.

D. Integral junction box with conduit fittings.

E. 0 – 10V dimmable with isolated lead wires.

F. Aluminum heat sink.

G. Self-flanged.

H. Gloves or other protective items shall be used when interacting with the reflector system. No finger prints, dirt, or oils shall be visible. Any indication of these shall require replacement of reflector system at no cost to manufacturer or owner.

2.5 RECESSED LINEAR

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Finelite Lighting.
2. Mercury Lighting.
3. Metalumen.
4. Delviro Energy.
5. Or approved equals. Refer to 265119-1.3-C.

B. Minimum lumens per lighting fixture schedule.

C. Integral junction box with conduit fittings.

D. Integral 0–10v dimming driver with isolated lead wires.

E. Flush, snap in retention style Lensed (type as per light fixture schedule).

F. Refer to plans for housing lengths required. Continuous runs up to 8 ft. long shall be provided with one lens. Lengths over 8 ft. long up to 16 ft. long shall be provided with two lenses. Where two lenses meet, there will be no gap or light leak. Lensing at end of run shall not have more than 1/32 of an inch gap. Any indication of light leaks or exceeding indicated gap length at end

of luminaire shall require replacement of lensing at no cost to owner. 4ft long lenses for Wall Wash style luminaires only will be acceptable.

G. For all recessed linear runs located in lay-in grid ceilings, luminaire shall extend from t-bar to t-bar with no end plates, filler sections, etc. submit factory drawings for verification.

H. Mounting hardware for each recessed linear luminaire run shall be coordinated with **all** other trades prior to ordering. Provide clearly defined submittal drawings indicating each location and associated hardware being provide at shop drawing level.

I. Extruded aluminum housing.

J. Refer to light fixture schedule General Notes.

K. All lensing shall be removed and cleaned per manufacturer recommendations after commissioning of lighting system for every single luminaire on project.

2.6 STRIP LIGHT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. LSI.
2. Visioneering.
3. Mercury Lighting.
4. Snowball Lighting.
5. Or approved equals. Refer to 265119-1.3-C.

B. Minimum lumens shall be per light fixture schedule.

C. Integral junction box with conduit fittings.

D. Aluminum housing with no plastic end caps.

E. Integral 0-10v dimming driver with isolated lead wires.

F. All parts and pieces painted after fabrication (room side and ceiling side, entire fixture assembly).

2.7 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers, and Globes:

1. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

2.8 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.9 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports: Sized and rated for luminaire weight.

E. Flush-Mounted Luminaire Support: Secured to outlet box.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls Attached to a minimum 20 gauge backing plate attached to wall structural members Attached using through bolts and backing plates on either side of wall.
2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 120 inches (6 m) in length.

2. Ceiling mount with pendant mount four-point pendant mount with 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 120 inches (6 m) in length.
3. Ceiling mount with hook mount.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire using approved fasteners in a minimum of four locations, spaced near corners of luminaire.

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

K. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

L. Emergency light fixtures shall be labeled “EM” and be visible from floor. Provide Phenolic labeling on ceiling grid at fixture with black letting and white background (verify location of name plate for fixtures that are wall mounted). Verify all labeling types, styles, lettering with Owner representative.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to generator power and retransfer too normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

D. At substantial completion of project/each phase, For all Linear runs (recessed, surface or suspended); remove all lensing (direct and/or indirect) and clean lensing as directed by manufacturer removing all dust, debris, cable clippings, lose or exposed wiring, screws, etc. Re-install all lensing and verify compliance with Light Fixture Schedule General Noting.

END OF SECTION

SECTION 311000 - CLEARING, GRUBBING & SITE DEMOLITION

PART 1 - GENERAL

1.1. DESCRIPTION

A. Demolition, clearing and grubbing required for this work includes, but is not necessarily limited to:

1. Removal and disposal of rock, concrete, timber, buildings, foundations, piping, lighting, signs, fencing, other site features indicated, and removal of all pavements as required, providing the work as shown on the Contract Drawings.

2. Clearing, grubbing and removal of herbaceous vegetation.

3. Removal and disposal of all debris.

4. Removal and disposal of items noted on the Contract Drawings.

B. The term, “clearing and grubbing and demolition”, as used herein, includes the removal and disposal of all existing objects except for those objects designated to remain down to twelve inches (12”) below existing ground in fill areas and to sub-grade elevations in cut areas, plus such work as is described in this Section of these Specifications and as shown on the Contract Drawings.

C. Tree branch and root pruning: Where clearing, grubbing, demolition or any other construction occurs within 10’ of the critical root zone, tree branch and root pruning shall be performed in accordance with SHA Specification Section 712 and 715 respectively under the supervision of a licensed tree expert.

1.2. QUALITY ASSURANCE

A. In addition to complying with all pertinent codes and regulations, the Contractor is to comply with the requirements of those insurance carriers providing coverage for this work.

1.3. JOB CONDITIONS

A. The contractor is to use all means necessary to prevent the spread of dust during performance of the work of this Section. Thoroughly moisten all surfaces as required to prevent dust being a nuisance to the public, neighbors, and concurrent performance of other work on the site. This includes but is not limited to providing a temporary supply of water for water trucks to moisten the soil at no additional cost to the owner.

B. On-site burning is not permitted.

C. Use all means necessary to protect existing objects designated to remain and, in the event of damage, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Owner at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1. MATERIALS

A. The Contractor subject to approval of the Owner shall provide material and equipment, not specifically described but required for proper completion of the work of this Section.

PART 3 - EXECUTIONS

3.1. PREPARATION

A. Notify the Owner, local county inspections and permits office and state department of the environment at least three (3) full working days prior to commencing the work of this Section.

B. Prior to all work of this Section, carefully inspect the entire site and all objects designated to be removed and to be preserved. Locate all existing active utility lines traversing the site and determine the requirements for their protection.

C. The Contract Drawings do not purport to show all objects existing on the site. Before commencing the work of this Section, verify with the Owner all objects to be removed and all objects to be preserved.

D. Schedule all work in a careful manner with all necessary consideration for neighbors and the public.

E. Preserve in operating condition all active utilities traversing the site and designated to remain.

3.2. DEMOLITION OF STRUCTURES

A. The Contractor shall demolish all structures where noted on the Drawings. The demolition shall include, but not be limited to, complete removal from the site of all pavements, walls, roofs, floors, footings, equipment, and all mechanical and electrical utilities, systems and equipment.

B. After all materials, equipment, etc., are removed, any and all trenches, pits, etc., shall be filled in accordance with Section 31 2000 - Earthwork. The final grades shall tie in with existing grades and shall not contain any low areas as water pockets.

C. After backfilling is completed, the Contractor shall fine grade and seed as needed in accordance with Section 32 9201 - Seeding and Sodding.

D. All materials removed shall be disposed of off-site in accordance with all legal requirements and at a site obtained by the Contractor and approved by the Owner.

3.3. CLEARING & GRUBBING

A. Clear all grasses and herbaceous vegetation.

B. Remove all surface rocks and all stumps, roots, and other vegetation within the limits of the construction as indicated on the Contract Drawings.

C. Clean out roots one inch (1”) in diameter and larger to a depth of at least twelve inches (12”) below the existing ground surface or sub-grade of new graded surface, whichever is lower. Treat roots remaining in the soil with weed killer. The killer shall be “Roundup” or another accepted by U.S.E.P.A. for residential uses and shall be applied as directed by the manufacturer.

3.4. CONSERVATION OF TOPSOIL

A. After the area has been cleared of vegetation the existing ground surface in the proposed building fill areas and to a minimum distance of ten feet (10') beyond the building limits shall be stripped of topsoil and root mat. In pavement area the stripping shall extend to a minimum of five feet (5') beyond pavement limits. In all other cases the stripping shall extend to the limits of disturbances.

B. Stockpile the topsoil in an area clear of new construction and at a location determined by the Contractor and approved by the Owner.

C. Maintain stockpile free from debris and trash.

D. Keep the topsoil damp to prevent dust and drying out.

E. Topsoil and organic material must be removed completely from paved, building, graveled, and structural fill areas. No topsoil shall be removed from the site until it is determined that there is sufficient topsoil for the required vegetated areas onsite and the owner provides authorization and is compensated for any material removed from the site.

F. Install and maintain any stockpile sediment controls in accordance with Contract Drawings requirements and the 2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control as amended.

3.5. CONSTRUCTION OF BARRICADES

A. Construct a temporary barricade around each structure to be preserved within limits of work shown on Contract Drawings. Barricades shall be suitable for their intended use as approved by the Owner.

B. **Do not** permit stockpiling of materials or debris within barricade areas, or areas to be protected, nor permit the earth surface to be changed in any way except as specifically approved by the Owner or as shown on the Contract Drawings.

3.6. REMOVAL OF DEBRIS

A. Remove all excess debris from the site and leave the site in a neat and orderly condition. Debris removed shall be disposed of off-site at a location to be obtained by the Contractor in accordance with all legal requirements and as approved by the Owner.

END OF SECTION

SECTION 312000 - EARTHWORK

PART 1 GENERAL

1.1. DESCRIPTION

A. The Contractor shall excavate, sheet, shore, de-water backfill and compact all excavations, and shall make all cuts and fills that may be necessary for constructing the work under this Contract. The above shall also include all subsurface explorations, test pits, grading, structures, trench excavation, and backfill. The Contractor shall furnish all labor, materials and equipment necessary for completion of the work.

B. Make excavations to the required sub-grade. The Contract price is understood to cover the removal of all materials to the depth and extent indicated on the Contract Drawings or specified herein. Owner will not pay for excavations carried below indicated grades without Owner written authorization.

C. The Contractor is to plan the circulation of construction traffic flow and types of equipment utilized to minimize the disturbances of the ground surface once the excavations are performed to within +/- 3 feet of final sub-grade elevations. This is to minimize as much as possible any pumping of sub-grades during construction and minimize disturbances that would lead to the undercutting and re-fill of sub-grades at a later time. If the Geotechnical Engineer or Owner observes that this consideration is not followed any area observed will be undercut and refilled by the Contractor at no additional cost to the Owner.

D. The Contractor shall allow for the temporary stockpiling of suitable material to be utilized onsite in controlled fills to maximize the most efficient excavation and filling process during the construction. Stockpiles shall be in compliance with the 2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control, as amended.

E. Where referred to in these Specifications, Standard Specifications shall mean the Maryland State Highway Administration (MSHA) Standard Specifications for Construction and Materials dated January 2008 as amended to date.

1.2. QUALITY ASSURANCE

A. The contractor, at his expense, shall contact MISS UTILITY or another Owner approved utility location company and have notification from the utility locating company of underground utility locations prior to any work being done on the site.

B. The Contractor will retain testing and monitoring services of a Registered Professional Geotechnical Engineer, at the contractor’s expense to perform field and laboratory testing during earthwork operations and to provide quality assurance of compliance with the Drawings and Specifications. Testing rates shall be determined by the Registered Professional Geotechnical Engineer to ensure certification of construction for acceptance by the governing agency. The contractor is to provide five copies of reports to the Owner.

Testing is to include but is not limited to:

1. Monitor earthwork operations, including approval of the ground surface prior to placement of fill, proof rolling, and performance of compaction tests.

2. Test and inspect sub grade preparation for slabs and pavements, including monitoring, proof rolling and confirming sub grade suitability prior to placement of base or surface

courses. Any soft or unsuitable material encountered should be replaced with suitable soils and placed in accordance with the Engineered Fill Placement Section below.

3. A minimum of one compaction test per 2,500 sq. ft. area should typically be tested in each lift placed, or as otherwise modified by the Geotechnical Engineer of Record during construction. The elevation and location of the tests should be clearly identified at the time of fill placement.

4. Provide pavement and pavement sub-base compaction and core samples.

5. Test and approve excavated, supplied, placed or backfilled aggregate or earth materials and the execution required for the construction of the storm water management devices, storm drain system, and any constructed underground utilities.

PART 2 - PRODUCTS

2.1. ENGINEEERED FILLS

A. The compacted fill materials shall be free of deleterious, organic, cobbles greater than 4 inches, or frozen matter, shall contain no chemical that may result in the material being classified as "contaminated," and shall be low expansive with a maximum Liquid Limit (ASTM D-423) and Plasticity Index (ASTM D-424) of 40 and 15, respectively. All fill material must be tested and approved under the direction of an experienced soils engineer prior to placement. If the fill is to provide non-frost-susceptible characteristics, it must be classified as clean GW, GP, SW or SP per Unified Soil Classification System (ASTM D-2487). Unacceptable fill materials include topsoil, organic materials (OH, OL) and high plasticity silts and clays (CH, MH).

2.2. POROUS FILL AND SELECT GRANULAR FILL FOR ON-GRADE SLABS

A. Aggregate material shall be clean, washed gravel or crushed stone, free of clay vegetable matter, loam and deleterious matter. Material shall be graded to meet AASHTO M-43, No. 57.

PART 3 - EXECUTIONS

3.1. ENGINEERED FILL PLACEMENT

A. The existing ground surface in the proposed pavements areas and to a minimum distance of 5 feet beyond the pavement limits is to be stripped of topsoil and root mat plus one foot for every one foot of fill that may be required.

B. All compacted fill, sub-grades, and grades shall be (a) underlain by suitable bearing material, (b) free of all organic, frozen, or other deleterious material, and (c) observed, tested and approved by qualified engineering personnel representing an experienced soil engineer. Preparation of sub-grades after stripping vegetation, organic or other unsuitable materials shall consist of (a) proof rolling to detect soft, wet, yielding soils or other unstable materials that must be undercut or stabilized (b) scarifying top 6 to 8 inches as required, (c) moisture conditioning the soils as required, and (d) re-compaction to same minimum in-situ density required. Note: Weather and construction equipment may damage compacted fill surface and reworking and retesting may be necessary to assure proper performance.

C. Fill materials should be placed in lifts not exceeding 8-inches in loose thickness and moisture conditioned to within 2+/- percentage points of the optimum moisture content. The fill soils shall be compacted to a minimum of 95% of the maximum dry density obtained in accordance with ASTM Specification D-1577 in order to obtain the degree of compaction specified. To obtain the optimum moisture content for proper compaction measures are to be employed by the contractor at no additional cost to the Owner. This includes but is not limited to the contractor scarifying to dry the surfaces of fill material or supplying a temporary supply of water for water trucks to moisten the soil, and rolling the fills to seal the surfaces, all performed under the direction of the Geotechnical Engineer.

D. Fill constructed over a sloping ground surface, which exceeds 1:V to 5:H is to be placed over a benched surface extending into firm ground. The horizontal extension of each bench shall be on the order of 2 to 5 feet.

E. Compaction shall be by approved multiple-wheel pneumatic tired rollers, vibratory rollers, sheepsfoot rollers or other types of acceptable rollers depending on the type of soil being compacted. Plate compactors or other suitable compaction equipment may be used where access limitations prohibit the use of roller-type compactors.

F. The filling operations shall be continued as specified above until the fill has been brought to the sub-grade shown on the Contract Drawings. Weaving or creeping of the soils beneath the roller shall be sufficient evidence that the required compaction has not been achieved or that the moisture content of the fill or sub-soils is excessive.

G. All engineered fill areas sub grade shall be proof rolled in the presence of the Geotechnical Engineer or his representative. Fill areas shall be proof-rolled using a loaded tandem dump truck with an axle weight of at least 10 tons. Soft or loose conditions identified by the proof roll shall be removed and replaced with suitably compacted sub grade fill as directed by the Geotechnical Engineer. If unsuitable sub-grades are encountered, that causes additional excavation below design grades as determined by the Geotechnical Engineer, notify the Owner immediately. Soil measurements are to be taken to determine the additional excavation and backfill volume for contract adjustment.

H. Excavation, filling, sub-grade and grade preparation shall be performed in a manner and sequence that will provide drainage at all times and proper control of erosion. Precipitation springs, and seepage water encountered shall be pumped or drained to provide a suitable working platform. Springs or water seepage encountered during grading/foundation construction must be called to the soil engineer's attention immediately for possibly construction procedure revision or inclusion of an under drain system.

I. When the work is interrupted by rain, filling shall not be resumed until determination by the Geotechnical Engineer indicates that the moisture content and density of the top six inches (6”) of fill conform to Specification requirements. The areas are to be scarified prior to the filling process continuing.

J. The Contractor shall stockpile all excavated materials to be used in backfilling, in areas designated by the Owner and shall maintain these stockpiles until material is utilized for backfilling. Care shall be taken by the

Contractor to prevent erosion in accordance with these Specifications. Excess materials not used for topsoil, backfilling and grading shall be disposed of off-site in accordance with Local County and State requirements.

K. The Contractor shall provide all necessary temporary drainage and keep the same operating until permanent drainage has been completed. If water is encountered in excavating, the Contractor shall provide and maintain pumps of sufficient capacity to remove the water while the excavations are being made and until foundations or bedding material have been constructed, or structures erected up to grade, and the excavation has been backfilled.

L. The Contractor shall support the side and ends of all excavations wherever necessary or directed with braces, sheeting; shores or stringers of quality and character required providing adequate support.

M. The Contractor shall, at his own expense, sustain in their places and protect from direct or indirect damage, all pipes, poles, utilities, walls, buildings, and other structures or property in the vicinity of the Contractor's work, whether above or below ground, or that may appear in the excavation. The Contractor shall at all times have a sufficient quantity of timber and plank, chains, ropes, etc., on-site and shall use them as necessary for sheeting his excavations and for sustaining or supporting any structures that are uncovered, endangered, threatened or weakened. The Contractor shall take all precautions in the presence or proximity of pipes, poles, walls, buildings and other structures and property of every kind and description in the vicinity of the Contractor's work, whether above or below the surface of the ground.

N. The Contractor shall be responsible for all damage and assume all expense for direct or indirect injury, caused by the Contractor's work, to any structure or to any person or property by reason of injury to any structure or to any person or property, whether such structures are or are not shown on the Contract Drawings.

O. The Contractor shall be responsible for the conditions of all excavations made by the Contractor. All slides and cave-ins shall be removed without extra compensation, at whatever time and under whatever circumstances slides and cave-ins may occur.

P. The neglect, failure, or refusal of the Owner/Engineer to order the use of bracing, sheeting, or a better quality or larger sizes of timber, or the giving or failure to give orders or directions as to the manner or methods of placing or driving sheeting, braces, or shores, shall not in any way or to any extent relieve the Contractor of any responsibility concerning the condition of excavations or of any of the Contractors obligations under the Contract.

Q. All excavation of every description shall be unclassified and be performed to the dimensions and elevations shown on the Contract Drawings. The Contractor will not be entitled to extra compensation for unusual materials encountered.

R. The Contractor shall proceed with caution in any excavation and shall use every means possible to determine the location and extent of underground structures, utilities, conduits, etc., prior to excavation and shall protect such facilities from damage or displacement during excavation. The Contractor shall be held strictly responsible for the repair and/or replacement of any

structure, pipeline, utility or other facility above or below the ground, which may be damaged in any way by the Contractor's operations.

S. All excavation materials shall be segregated into suitable and unsuitable materials. The Geotechnical Engineer shall determine the suitability of all materials. Only suitable materials shall be used for filling, backfilling.

T. The excavation for all structures shall be to the elevations shown on the Contract Drawings and shall be of sufficient width to provide for the proper erection of structures. Where forms are required for concrete structures, such excavations shall be wide enough to accommodate form erection and stripping and where excavations are sheeted, proper clearances shall be provided between the forms and the braces, stringers or wailing strips. No braces, stringers or wailing strips shall be left within any portion of the masonry. Excavations shall be deep enough to accommodate aggregate base course foundations where indicated on the Contract Drawings. If the Contractor excavates below the elevations specified for footings and other foundations, he shall not backfill the excavation, unless specifically approved by the Geotechnical Engineer. In all cases, footings must bear on undisturbed earth except as shown on the Drawings or as approved by the Geotechnical Engineer. Any over excavation and resultant redesign or increase cost of footings shall be borne by the Contractor at no expense to the Owner.

U. If rock is encountered in excavations or unsuitable sub-grades are encountered, that causes additional excavation below design grades notify the Owner immediately. The depth of the over-excavation is to be recorded by the Registered Professional Geotechnical Engineer to determine the additional excavation and backfill volume for contract adjustment. The presence or absence of rock, or the increase or decrease in quantities of rock indicated within limits of excavations, will not entitle the Contractor to additional compensation above or beyond the prices bid.

V. The structures shall be supported on suitably compacted fill or firm natural ground. The existing ground surface, after stripping topsoil and root mat in structure and site fill areas shall be compacted to achieve a minimum in-place density in accordance with Section 3.1C of this specification.

W. Permanent and temporary slopes shall be constructed at or flatter than maximum slopes permitted by OSHA and local regulations and determined safe by specific stability analyses.

X. Wherever, in the opinion of the soils engineer of the Owner's Representatives, an unstable condition is being created either by cutting or filling, the work shall not proceed into that area until an appropriate geotechnical exploration and analysis has be performed and the grading plan revised, if found necessary.

3.2 BELOW GRADE RETAINING WALL BACKFILL

A. To minimize excessive pressures against the below-grade retaining walls, and to reduce the settlement of the wall backfill, the wall backfill shall be compacted to 95% of the maximum dry density determined in accordance with ASTM Specification D-698, Standard Proctor Method. Backfill materials

which are placed behind below-grade walls shall be classified as an SC or more granular, free of organic materials and debris, free-draining (or with proper drainage provisions), non-frost susceptible, and should not include any highly plastic clays or silts (CH or MH). It is imperative that no CH or MH soils be used as backfill, due to the shrink-swell potential of these materials. The backfill should also have a Liquid Limit less than 40 and Plasticity Index of less than 15. The fill placed adjacent to the below-grade walls shall not be over compacted. Heavy earthwork equipment should maintain a minimum horizontal distance away from the below-grade walls of 1 foot of vertical wall height. Lighter compaction equipment should be used close to the below-grade walls.

3.3 PAVEMENT CONSTRUCTION

A. All aggregate base course materials beneath pavements shall be compacted to at least 95 percent of their maximum dry density utilizing the Modified Proctor (ASTM D1557). In accordance with the Maryland State Highway Administration requirements, the asphalt shall be placed and compacted to within 92% to 97% of the maximum theoretical density as obtained using the asphalt Marshall Value, and placed in accordance with specification requirements.

3.4. TOLERANCES

3.4.1. Grading Tolerances

A. Excavation and fill tolerance shall be as follows:

1. Structure and site pavement and sidewalk areas: plus or minus ½ inch
2. Site non-paved areas: Plus or minus 1 inch.

END OF SECTION

SECTION 321216 - HOT MIX ASPHALT PAVEMENT

PART 1 - GENERAL

1.1. DESCRIPTION

A. Perform all work necessary and required for the construction of the project as indicated. Such work includes but is not limited to the following:

1. Hot mix asphalt pavement, aggregate base, and pavement sub grade.

B. Where referred to in these Specifications, Standard Specifications shall mean the Maryland State Highway Administration (MSHA) Standard Specifications for Construction and Materials dated January 2008, amended to date.

1.2. QUALITY ASSURANCE

A. The contractor will retain testing and monitoring services of a Registered Professional Geotechnical Engineer, to perform field and laboratory testing during sub grade and paving operations and to provide quality assurance of compliance with the Drawings and Specifications. Testing rates are to be determined by the Registered Professional Geotechnical Engineer in accordance with the stated specification to ensure certification of construction for acceptance by the owner or governing agency.

1. Pavement Sub grade testing will be required as stated in Section 31 2000 of these Specifications.

2. Graded Aggregate Base Course testing required will be in accordance with Standard Specification Section 501, compaction is to be 98%.

3. HMA Testing required will be compaction testing and Core Method Testing in accordance with Standard Specification Section 504 with the exception of the number of tests (4 Core Tests and 8 compaction tests will be required, and the location of the tests will be determined by the OWNER). The tests are to yield no less than the tolerances stated within this specification and the Standard Specification Section 504.

4. The contractor is to provide five copies of reports for all testing to the Owner.

1.3. SUBMITTALS

A. The contractor is to provide the Owner with submittals for all materials covered under this section, and material certificates. Certificates are to be signed by Material Producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements. Asphalt mix designs (preapproved by the MSHA) for each type Hot Mix Asphalt specified shall be submitted.

1.4. JOB CONDITIONS

A. Establish and maintain required lines and elevations, no puddles are to occur once final hot mix asphalt surface is provided.

PART 2 - PRODUCTS

2.1. PAVEMENT SUBGRADE

A. All pavement sub grade shall be as required in Section 31 2000, and as stated on plans.

2.2. GRADED AGGREGATE BASE COURSE or BANK RUN GRAVEL

A. Graded Aggregate Base Course or Bank Run Gravel material as indicated on Drawings is to be in accordance with Standard Specification – Section 501, and as stated on plans.

2.3. HOT MIX ASPHALT (HMA) PAVEMENTS

A. Surface course materials are to be in accordance with Standard Specification – Section 504 HMA Pavement, and as stated on plans.

B. Base course materials are to be in accordance with Standard Specification – Section 504 HMA Pavement, and as stated on plans.

C. Tack coat material is to be in accordance with Standard Specification – Section 504.

2.4. FABRIC

A. Geotextile reinforcing fabric is to be Tensar BX1200 or as directed by geotechnical engineer (If required)

PART 3 - EXECUTIONS

3.1. PAVEMENT SUB-GRADE

A. The pavement sub grade preparation shall be in accordance with Section 32 2000 in addition to requirements of this section.

B. The pavement sub grade preparation shall be conducted in the presence of the geotechnical engineer. The completed work shall be tested and approved by the geotechnical engineer prior to construction of the succeeding work. Finished sub-grade shall be true to required lines and Sections for paving and shall be hard, uniform and smooth.

C. Pavement sub grade shall be proof rolled using a loaded tandem dump truck with an axle weight of at least 10 tons. Soft, loose or wet conditions identified during the proof roll are to be corrected in accordance with the following procedures:

1. Unsuitable materials shall be removed and replaced with suitable fill materials compacted to the required density.
2. The contractor shall be diligent in identifying unsuitable materials.
3. High plasticity (CH) soils shall be identified by conducting Atterberg Limits testing.
4. Any soft or unsuitable materials encountered during the proof rolling shall be removed and replaced with an approved backfill compacted to the criteria in section 32 2000 Engineered Fill Placement.

D. The Contractor shall proceed with the placement of the graded aggregate base course within twenty-four (24) hours after sub grade approval. If precipitation occurs during this operation, an evaluation by the Geotechnical Engineer shall be made before proceeding.

E. Longitudinal under drains shall be installed in poorly drained areas as directed by the Geotechnical Engineer or his representative.

F. Any and all additional work associated with pavement sub grade preparation shall be documented by the Geotechnical Engineer or his representative and approved by the Owner before implementation.

G. A supplemental CBR testing program is to be conducted on the pavement sub grade soils, after mass grading and utility installation and backfill, and just prior to pavement construction. The design of the pavement section may require modification based on the results of the supplemental CBR testing.

3.2. GRADED AGGREGATE BASE COURSE

A. Sufficient Graded Aggregate Base Course shall be uniformly spread to give the required thickness when compacted.

B. Aggregate Base Course Construction shall be in accordance with Standard Specification - Section 501.

C. Aggregate base course shall be maintained in its finished condition until the hot mix asphalt pavement is placed.

D. The contractor is to proceed with the binder course within (24) hours of the satisfactory placement of the graded aggregate base. If precipitation occurs during this operation, an evaluation by the Geotechnical Engineer shall be made before proceeding.

3.3. HOT MIX ASPHALT PAVEMENT

A. Hot mix asphalt pavements are to be constructed in accordance with Standard Specification – Section 504.

B. The hot mix asphalt pavements shall be delivered to the job site and applied to the prepared surfaces with approved trucks, spreaders and finishing machines in such manner as to produce the required thickness pavement courses.

C. Contractor shall proceed with the construction of the binder course within twenty-four (24) hours of the completion of the base course. If precipitation occurs during this operation, an evaluation by the Geotechnical Engineer shall be made before proceeding.

D. Traveled binder course shall be cleaned before application of the surface course.

E. Areas to receive hot mix asphalt pavement or rigid structures that abut hot mix asphalt pavement are to be tack coated prior to placement of pavement. This includes binder course and surface course. Tack coats are to be applied in accordance with Standard Specification – Section 504.

3.4. FABRIC

A. Geo-textile reinforcing fabric is to be installed with manufacturer’s recommendations (If required).

3.5. HOT MIX ASPHALT PAVING AND AGGREGATE BASE TOLERANCES

A Following are maximum permissible deviations from specified hot mix asphalt pavement and aggregate base thickness:

1. Thickness of HMA surface and HMA binder course (plus 1/4 inch no minus) as indicated on Contract Drawings.

2. Thickness of aggregate base course (plus 1/2 inch no minus) from grades determined from Contract Drawings.

B. Following are maximum permissible surface smoothness. Compact each course to produce a surface smoothness within the following tolerances as determined by using a ten-foot (10') long straight edge applied transversely or longitudinally to pavement areas:

1. Base Pavement: 1/4 inch

2. Surface Pavement: 1/8 inch

3.7. CLEAN UP

A. After paving work is complete, remove excess stone, gravel, millings, and hot mix asphalt pavements, rubbish, etc., from site.

3.8. CORRECTION OF DEFECTIVE WORK

A. Settlement, low spots, raveling out of surface or edges and any other defects in workmanship or materials which appear within one (1) year of substantial completion of project as a whole shall be repaired by the Contractor to original design criteria specified at no additional cost to the OWNER.

END OF SECTION

SECTION 321313 - CONCRETE FOR SITE WORK

PART 1 - GENERAL

1.1. DESCRIPTION

A. The work under this item shall include all labor, materials, tools, equipment, and services for performing of all work necessary to complete the following concrete items but not limited to curbs, curb & gutter, sidewalks, footings, and foundations as indicated on the Civil Contract Drawings.

B. Where referred to in these Specifications, Standard Specifications shall mean the Maryland State Highway Administration (MSHA) Standard Specifications for Construction and Materials dated January 2008, amended to date.

1.2. QUALITY ASSURANCE

A. Deliver, store, and handle materials in accordance with manufacturer's instructions. Materials are to be stored in areas that will not impede construction progress.

B. The contractor will provide monitoring and testing by a Registered Professional Geotechnical Engineer, at the contractor's expense, to ensure proper construction in accordance with Specifications. On-site concrete pours are to be tested in accordance with the ASTM Standards C-94/ C94M 04 for each concrete batch. Any areas not constructed in accordance with specifications will be removed and replaced by Contractor at no expense to the Owner. Testing rates are to be determined by the Registered Professional Geotechnical Engineer to ensure certification of construction for acceptance by the governing agency. Five copies of testing reports are to be provided to the owner.

1.3. SUBMITTALS

A. The contractor is to provide the Owner with five (5) submittals for all materials covered under this section, and material certificates. Certificates are to be signed by Material Producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

PART 2 - PRODUCTS

2.1. MATERIALS

A. Portland cement concrete and related products are to be in accordance with Standard Specification – Section 902. Mix designs as follow or as stated on contract drawings:

1. Curb and Gutter – Mix No. 2

2. Sidewalks and Mow Strip – Mix No. 2

3. Concrete Pads / Valley Gutter – Mix No. 6

B. Reinforcement steel and welded wire fabric is to be in accordance with Standard Specification - Section 908.

1. Joint sealer is to be in accordance with Standard Specification – Section 911.

2. Preformed joint filler is to be in accordance with Standard Specification - Section 911.

PART 3 - EXECUTIONS

3.1. CONSTRUCTION METHODS

A. Curb, and combination curb and gutter forming, depressions, openings, finishing, and joints, shall be as shown on Drawings and are to be performed in accordance with Standard Specification – Section 602.

B. Structures are to be constructed in accordance with Standard Specifications Section 305.

3.2 ACCEPTANCE

3.2.1 All site concrete shall be placed with self-levelling sealants between walks or curbs and building type structures (buildings, retaining walls, columns, and vertical structures).

3.2.2 Cracks of any size and width shall be rejected. Walks, curbs and other site concrete shall be removed to nest expansion joint, sub-soils compacted or replaced and new walks, curbs or other concrete work provided at no additional cost to the owner.

3.2.3 Warranty period is two years from the date of substantial completion. Remove and replace any cracked or broken concrete with 7 days of notice.

3.2.4 Provide warranty information with respect to concrete company and point of contact for warranty repairs and replacement. Provide as part of Final Close-out Documents.

END OF SECTION

SECTION 329201 - SITE SEEDING AND SODDING

PART 1 - GENERAL

1.1. DESCRIPTION OF WORK

A. This Section pertains to the preparation, establishment and maintenance of lawn areas outside of the plaza including seeding, Sodding and topsoiling, fertilizing, mulching, and watering operations.

B. Where referred to in these Specifications, Standard Specifications shall mean the Maryland State Highway Administration (MSHA) Standard Specifications for Construction and Materials dated January 2008, amended to date.

C. Where referred to in these Specifications, SCD Specifications shall mean the 2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control.

1.2. SPECIAL REQUIREMENTS

A. Seeding Seasons: Seeding shall be performed between March 1st and May 15th or between August 15th and October 15th. No seeding shall be done between October 15th and March 1st and a supplement irrigation system shall be used if seeded between May 15th and August 15th.

B. Sodding Season: Sodding may be performed anytime the ground is not frozen or excessively wet or dry, between April 1, and December 1.

1.3. QUALITY ASSURANCE

A. The contractor will retain testing and monitoring services of a Soil Testing Laboratory listed on the Home and Garden information Center web site(http://www.hgic.umd.edu//content/links.cfm) at the University of Maryland, for Soils Testing as required, to perform field and laboratory testing and obtain recommendations of fertilizer and lime that will need to be applied to the site prior to seeding and Sodding operations and to provide quality assurance of compliance with the Drawings and Specifications. The application rates for this project will be adjusted in accordance with the recommendations obtained from the laboratory testing. Any areas not constructed in accordance with specifications will be removed and replaced by Contractor at no expense to the Owner. The contractor is to provide five copies of reports to the Owner

B. Deliver, store, and handle materials in accordance with manufacturer's instructions. Materials are to be stored in areas that will not impede construction progress.

1.4. SUBMITTALS

A. The contractor is to provide the Owner with five (5) submittals for all materials covered under this section, and material certificates. Certificates are to be signed by Material Producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

PART 2 - PRODUCTS

2.1. SEED

A. Seed is to be incompliance with the Standard Specifications Section 705 for Region 3 and SCD Specification B-4-4 Zone 7a.

1. For Lawn areas and Athletic Fields use: Roadside seed mix with additive: MSHA Mix No. 1c (85% Tall Fescue – certified seed only, 10% Kentucky Bluegrass –certified seed only, 5% Perennial Rye Grass – certified seed only or as recommended from SCD Specification Table B.3. Additive Secrecies Lespedeza – certified seed only for slope areas of 3:1 or greater only.

2. Temporary Seed: 95 percent Barley or Rye, five percent (5%) Foxtail Millet or as recommended from SCD Specification Table B.1.

3. For slope areas 3:1 or greater utilize MSHA Mix No. 1c with additive Secrecies Lespedeza or as recommended from SCD Specification Table B.3.

2.2. TOPSOIL AND SUBSOIL

A. The Contractor shall furnish all topsoil, labor, material, and equipment required to complete the work described herein in strict accordance with the Drawings and/or terms of the Contract.

B. Topsoil shall be sandy loam, clay loam, loam, silt loam, sand clay loam, meeting SCD Specification Section B-4-2 or other soil approved by the Owner. It shall not have a mixture of subsoil and shall not contain any slag, cinders, and stones, lumps of soil, sticks, roots, trash or other plants or plant parts of Bermuda grass, Quack grass, Johnson grass, Nutsedge, Poison Ivy, Canada Thistle, or others as specified. All topsoil shall be tested by a recognized laboratory for Ph and soluble salts. A Ph of 5.2 to 7.0 is required for the top four (4) inches of subsoil and topsoil. Soluble salts shall not be higher than 500 parts per million.

2.3. FERTILIZER AND LIME

A. All fertilizers shall be uniform in composition, free flowing, and suitable for application with approved equipment. Fertilizers shall be delivered to the site fully labeled according to applicable state fertilizer laws and shall bear the name, trade name or trademark, and warranty of the producer. Turf areas are to be fertilized with 10-22-22.

B. Lime shall be ground agricultural limestone and shall contain not less than 85 percent calcium and magnesium carbonates. Dolomitic (magnesium) limestone shall contain at least 10% magnesium as magnesium oxide and 85 percent calcium and magnesium carbonates. Limestone shall conform to the following gradation: No. 10 sieve 100 percent passing by weight, No. 20 sieve 98 percent passing by weight, and No. 100 sieve 50 percent passing by weight.

2.4. STRAW MULCH

A. Straw shall consist of thoroughly threshed cereal grains. Straw shall be free of noxious weeds and weed seeds as specified in the Standard Specification Section 920. Straw shall be visually inspected by the Contractor and certified in writing to the Owner prior to unloading at site to ensure that it is free from mold, foreign substances, plant parts of Canada Thistle, Johnson grass, or Phragmites, and is in an air-dry condition suitable for placing with mulch blower equipment.

2.5. MULCH BINDER

A. Mulch binder shall be in accordance with Standard Specification –Section 920

2.6. WATER

A. Water is to be potable free from oil, acid alkali, salt and other substances harmful to the growth of grass and shall be in accordance with Standard Specification –Section 920

PART 3 - EXECUTIONS

3.1. SUBSOIL

A. The areas to which these Specifications apply and on which topsoil is to be spread shall be as indicated on the Drawings or as otherwise specified. This Contractor shall furnish equipment, labor, and materials necessary for preparation of the specified areas.

B. The areas to receive topsoil are to be in conformance with the Drawings and/or other applicable Specifications and shall be maintained in a true and even grade.

C. After the areas to be topsoil have been brought to sub-grade, and immediately prior to dumping and spreading the topsoil, the sub grade shall be loosened by disking or by scarifying to a depth of at least four inches (4”) to permit bonding of the topsoil to the subsoil and to incorporate lime.

D. Acceptance shall be given by the Owner upon satisfactory completion of each Section as indicated on the Drawings or as otherwise specified.

3.2. TOPSOIL

A. No seed shall be placed on soil, which has been treated with soil sterilants until sufficient time has elapsed to permit dissipation of toxic materials. This Contractor shall assume full responsibility for loss or damage to seed arising from improper use of sterilants, or due to his failure to allow sufficient time to permit dissipation of toxic materials, whether or not such sterilants are specified herein.

B. The contractor will pull two representative topsoil samples from the stockpile area within one week of stockpiling of topsoil to be tested to determine the Ph and provide any recommendations on lime and fertilizer adjustments.

C. The topsoil shall be uniformly distributed on the designated areas and it shall be a minimum depth of four inches (4”) after firming. Compacting shall be with a lawn roller weighing not less than 90 pounds per foot of roller width. Spreading shall be performed in such a manner that seeding can proceed with a minimum of additional soil preparation and tillage. Any irregularities in the surface resulting from topsoiling or other operations shall be corrected in order to prevent the formation of depressions or water pockets. Topsoil shall not be placed while in a frozen or muddy condition, when the sub grade is excessively wet, or in a condition that may otherwise be detrimental to property grading or proposed seeding.

D. After the topsoil has been spread and the final grades approved, it shall be cleared of all grade stakes, surface trash and other objects that would hinder maintenance of seeded and planted areas. Paved areas over which hauling operations are conducted shall be kept clean, and any soil, which may be brought upon the surfacing, shall be promptly removed. Topsoil shall be raked, in a minimum of two directions, before seeding to eliminate all deleterious material over three-quarters of an inch (3/4”).

E. The Owner upon satisfactory completion of each Section shall give acceptance or area indicated on the Drawings or as otherwise specified.

3.3. LIME AND FERTILIZER

A. Lime shall be distributed uniformly over the entire area to be seeded as follows: topsoil 4000 pounds per acre.

B. Fertilizer shall be applied uniformly over the entire area to be seeded as follows: turf areas 1000 pounds per acre.

C. Lime and fertilizer are to be mixed into the top four (4") of subsoil and topsoil as specified by disking, harrowing, or another approved method.

D. Any undulations or irregularities in the surface resulting from fertilizing, liming, tilling, flooded, washed-out or otherwise damaged areas or other causes shall be leveled prior to seeding. All grades re-established by the Contractor shall be in accordance with the Drawings and/or other applicable Specifications.

E. The surface to be limed and fertilized shall be cleared of all trash, debris, and stones larger than one inch (1") in diameter and of all roots, brush, wire, grade stakes, and other objects that would interfere with planting and maintenance operations.

F. The Owner upon satisfactory completion of each Section shall give acceptance or area as indicated on the Drawings or as otherwise specified.

G. The Contractor shall be responsible for maintaining the accepted areas, which are to be seeded until the seeding operations begin.

3.4. SEEDING

A. All areas to be seeded shall be hydro seeded.

B. Approved turfgrass seed mix to be applied at a rate as stipulated in SCD Specification Section B-4-5.

C. No seeding shall be done during windy weather nor when ground is wet or frozen.

D. Aqueous mix of water, fertilizer and lime shall be constantly agitated until applied.

E. Care shall be exercised to insure uniform coverage and protection of existing plants.

F. Excess and waste material shall be removed from the site daily. All walks, signs, light posts, roadways and structures shall be left clean.

G. Areas not to be seeded should be protected during seeding operations so as to not have seed deposited in these areas. If grass does grow in these areas, the areas are to be treated with Roundup applied in accordance with manufacturer's requirements to eliminate grass growth and dead grass is to be removed from the area.

H. Seeding Contractor shall be responsible for any damage to new or existing plant material resulting from hydro seeding.

I. Contractor may apply seed outside the recommended seeding times, but must accept full responsibility for an acceptable stand of grass.

J. Contractor may dry-seed using conventional drop or broadcast spreaders for supplemental seeding or stabilization required due to removal of sediment controls.

K. Areas dry-seeded will require incorporating seed to a one-eighth to one-quarter inch (1/8" to ¼") depth in the surface of the soil. Two (2) applications of seed are to be applied perpendicular to each other. Entire area is to be rolled with weighted roller.

L. On all slopes and in all drainage swales indicated for seeding, use stabilization matting in areas shown on Drawings.

M. On all seeded areas, the Contractor shall produce a dense, well-established vegetated cover. The Contractor shall be responsible for repairing all eroded areas, dead areas, and bare spots until the Owner has accepted the lawn areas.

3.5. MULCH

A. Mulch application rate is to be in accordance with Standard Specification 705: 4000 lbs per acre and secured by the Wood Cellulose Fiber.

3.6. MULCH BINDER

A. Mulch binder – Wood Cellulose Fiber shall be uniformly applied without displacing the mulch. The binder is to be applied at a rate of 750 lbs per acre in turf areas.

3.7. TEMPORARY SEEDING

A. Temporary seeding is to be in compliance with Standard Specification - Section 704: 125 lbs per acre.

3.8. TEMPORARY MULCH

A. Temporary Straw mulch is to be in compliance with Standard Specification - Section 704: 4000 lbs per acre.

3.9. TEMPORARY MULCH BINDER

A. Temporary mulch binder is to be in compliance with Standard Specification - Section 704 and conform for wood cellulose fiber: 750 lbs per acre.

3.10. WATERING

A. Thoroughly irrigate to a depth sufficient to moisten soil so that the seed and soil are thoroughly wet in turf areas.

B. It is the Contractor’s responsibility to provide all necessary water for the installation and maintenance of the seed in turf areas.

3.11. MAINTENANCE

A. Contractor shall not mow seeded areas until majority of grass has reached three (3”) inches, and not later than the majority of grass areas reaching five (5) inches.

B. Seeded areas shall be maintained by contractor for a minimum of 30 days from the first mowing by contractor.

C. The Contractor shall be responsible for the immediate repair of all washouts, dead areas, or bare spots until seeded areas are accepted.

D All seeded areas shall be protected from traffic damage by barricades, signs, or other appropriate means. Any damage occurring before acceptance of the areas shall be repaired at the Contractor’s expense.

E. The Contractor shall over-seed, mulch and feed every six weeks until lawn has 85% coverage. Site visits to maintain lawn shall require Contractor to check in with owner representative once the site is occupied by the owner.

F. Any areas disturbed by the Contractor shall be fully restored at the time they are available for restoration.

3.12. WARRANTY

A. Warranty shall be for two growing seasons after acceptance by the owner. All turf and lawn plantings shall be alive and in satisfactory growth (capable of a minimum 3-inch stand of grass) at the end of the warranty period.

END OF SECTION

SECTION 330510 - CONCRETE FOR UTILITY WORK

PART 1 - GENERAL

1.1. DESCRIPTION

A. The work under this item shall include all labor, materials, tools, equipment, services and performing of all work necessary to complete concrete work included in the Contract.

B. Where referred to in these Specifications**,** Standard Specifications shall mean the Maryland State Highway Administration (MSHA) Standard Specifications for Construction and Materials dated January 2008, amended to date.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials for this item shall be in accordance with applicable sections of MSHA Standard Specifications for:

Section 911	Joints
Section 908	Reinforcement Steel
Section 902	Portland Cement Concrete and Related Products.

B. Unless otherwise noted on the Contract Drawings, all concrete shall be SHA Mix No. 3 - 3500 psi. For each concrete mix, submit complete concrete mix design to the Engineer for approval.

PART 3 - EXECUTIONS

3.1 CONSTRUCTION METHODS

A. Construction requirements shall be in accordance with the St. Mary’s County Metropolitan Commission (METCOM) Standards and Specifications.

3.2 TESTING

A. The Contractor will coordinate and arrange all testing that the owner requires to be performed as part of the work. The cost of testing laboratory services shall be at contractor’s expense.

END OF SECTION

SECTION 330550 - EXCAVATION, BACKFILL AND PROTECTION OF TRENCHES

PART 1 - GENERAL

1.1. DESCRIPTION

A. The Contractor shall perform all excavation, refill, filling, grading, and compaction, required for the construction of structures and the installation of pipe lines including, but not limited to sheeting, shoring, sheet piling and bracing, tunneling, dewatering, accommodation of drainage flows, support and protection of utilities and other structures encountered in the work cutting and restoring paving, furnishing and maintaining adequate barricades, warning signs, and other means of protecting the public, disposal of surplus excavated materials and restoration of all surfaces to their original condition except as otherwise shown or specified.

B. Excavation shall be in open cut unless otherwise approved or stated elsewhere on drawings.

C. Equipment having contact with any hard surface roads must be equipped with rubber tires or treads or the payment shall be otherwise suitably protected from damage.

D. Trenching on hard surface roads will be permitted only, when the hard surface has first been cut for its full depth along the trench lines, using a mechanical spade, pavement saw or similar equipment.

E. Where referred to in these Specifications**,** Standard Specifications shall mean the Maryland State Highway Administration (MSHA) Standard Specifications for Construction and Materials dated January 2008, amended to date.

1.2. QUALITY ASSURANCE

A. The contractor will provide monitoring and testing by a Registered Professional Geotechnical Engineer, at the contractor’s expense, to ensure proper construction in accordance with Specifications. Any areas not constructed in accordance with specifications will be removed and replaced by Contractor at no expense to the Owner. Testing rates are to be determined by the Registered Professional Geotechnical Engineer to ensure certification of construction for acceptance by the reviewing agency. Testing rates are to be determined by the Registered Professional Geotechnical Engineer to ensure certification of construction for acceptance by the governing agency. Electronic copies of testing reports are to be provided to the owner.

1.3. SUBMITTALS

A. The contractor is to provide the Owner with submittals for all materials covered under this section, and material certificates. Certificates are to be signed by Material Producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

PART 2 - PRODUCTS

2.1. MATERIALS

A. Porous fill aggregate material shall be clean, washed gravel or crushed stone, free of clay, vegetable matter, loam and deleterious matter. Material shall be graded to meet AASHTO M-43, No. 57 or as stated on drawings.

B. Trench and structure backfill shall consist of granular soils meeting the requirements for classifications GM, GP, GW, SM, SP, or SW as determined in accordance with the USCS (ASTM D-2487). The backfill soils shall be non-plastic.

PART 3 - EXECUTIONS

3.1. TRENCH EXCAVATION

A. Trenches shall be excavated to the necessary width and depth as shown on the Contract Drawings where sheeting is used, the maximum width below the top of the pipe,as prescribed above, shall be measured between the interior faces of the sheeting as driven, but in no case shall stringers or waling-strips be so placed as to interfere with the proper compaction of the earth under and around the pipe. In case the sheeting does not extend below a point of six inches (6”) above the pipe as laid, the maximum width allowed shall be measured between the faces of the excavation below the bottom of the sheeting.

B. Bell-holes shall be excavated in the bottom and sides of trenches wherever to permit the proper making of joints, without extra payment.

C. If trenches are in fill areas, the filling operation is to be provided to a minimum of (1) feet above the top of the pipe before the trench is excavated.

D. The contractor should avoid stockpiling excavated materials immediately adjacent to the excavation walls. We recommend that stockpiled materials be kept back from the excavation a minimum distance equal to 1/2 the excavation depth to limit surcharging the excavation walls. If this is impractical due to space constraints, the excavation walls should be retained with bracing designed for the anticipated surcharge load.

3.2. LENGTH OF OPEN TRENCH

A. No greater length of trench at any location shall be left open in advance of the completed structure placed therein than shall be authorized or directed. The Owner shall be empowered, to require the refilling of open trenches over completed pipe lines if, in his judgment, such action is necessary. The Contractor shall have no claim for extra compensation even though to accomplish said refill he is compelled temporarily to stop excavation or other work at any place.

B. If work is stopped on any trench for any reason except by order of the Owner and the excavation is left open for an unreasonable length of time in advance of construction, the Contractor shall if so directed, refill such trench at his own cost and shall not again open said trench until he is ready to complete the structure or pipeline therein.

C. If the Contractor shall refuse or fail to refill such trench completely within forty-eight (48) hours after said notice the Owner shall be authorized to have the work done by other means and the Owner shall charge the expense thereof to the Contractor and retain the same out of any monies due or to become due to the Contractor under the Contract.

3.3. ACCOMMODATION OF TRAFFIC

A. During the progress of the work site access shall be kept open for the passage of vehicles unless otherwise authorized. Site access shall not be unnecessarily obstructed and unless the Owner and shall authorize the complete closing of the site access the Contractor shall take such measures, at his own expense, as may be necessary to keep the site access open for traffic.

B. The Contractor shall construct and maintain, without compensation, such adequate and proper signs, warnings, railings, bridges and other safety devices over or in the vicinity of all excavations as may be necessary or as directed for the purpose of accommodating vehicles.

C. When an access is closed, signs shall be erected to redirect traffic and prevent unnecessary delays and annoyance. Such signs shall be kept in place as long as the access remains closed.

D. In the event that an access is closed the Contractor shall notify the Engineer as what access will be closed and the length of time such access is expected to be closed to traffic.

3.4. ACCOMMODATION OF DRAINAGE

A. Pipelines and structures shall be kept clean at all times. No damming or ponding of water will be permitted, unless otherwise approved.

B. The Contractor shall be responsible for all necessary diversion, including pumping of drainage flow.

C. Such drainage facilities as necessary shall be installed which will permit the free and uninterrupted flow of the surface water before any surfacing is placed. When side and outlet ditches provide the principal means for drainage, the cutting of such ditches for the disposition of surface water shall be the first step in the grading operation. The Contractor shall maintain ditches and any existing or constructed pipeline and structures open and free from leaves and other debris until final acceptance of the work.

3.5. DEWATERING EXCAVATIONS

A. The Contractor shall provide all necessary temporary drainage and keep the same operating until permanent drainage has been completed. If water is encountered in trenching, the Contractor shall provide and maintain pumps of sufficient capacity to remove the water while the trenching is being made and until bedding material have been constructed, or structures erected up to grade, and the excavation has been backfilled.

3.6. ROCK EXCAVATION OR UNSUITABLE SUB-GRADES

A. If rock is encountered in excavations or unsuitable sub-grades are encountered, that cause additional excavation below design grades notify the Owner immediately. Soil measurements are to be taken by the contractor under the direction of the Geotechnical Engineer to determine the additional excavation and backfill volume for Contract adjustment. The presence or absence of rock, or the increase or decrease in quantities of rock indicated within limits of excavations, will not entitle the Contractor to additional compensation above or beyond the prices bid.

3.7. BRACING OF SHEETING

A. The Contractor shall, at his own expense, sustain in their places and protect from direct or indirect damage, all pipes, poles, utilities, walls, buildings, and other structures or property in the vicinity of the Contractor’s work, whether above or below ground, or that may appear in the excavation. The Contractor shall at all times have a sufficient quantity of timber and plank, chains, ropes, etc., on-site and shall use them as necessary for sheeting his excavations and for sustaining or supporting any structures that are uncovered, undetermined, endangered, threatened or weakened. The Contractor shall take all precautions in the presence or proximity of pipes, poles, walls, buildings and other structures and property of every kind and description in the vicinity of the Contractor’s work, whether above or below the surface of the ground. The Contractor shall be responsible for all damage and assume all expense for direct or indirect injury, caused by the Contractor’s work, to any structure or to any person or property by reason of injury to any structure or to any person or property, whether such structures are or are not shown on the Contract Drawings.

B. The Contractor shall be responsible for the conditions of all excavations made by the Contractor. All slides and cave-ins shall be removed without extra compensation, at whatever time and under whatever circumstances slides and cave-ins may occur.

C. The neglect, failure, or refusal of the Owner to order the use of bracing, sheeting, or a better quality or larger sizes of timber, or the giving or failure to give orders or directions as to the manner or methods of placing or driving sheeting, braces, or shores, shall not in any way or to any extent relieve the Contractor of any responsibility concerning the condition of excavations or of any of the Contractors obligations under the Contract.

3.8. EXCAVATION BELOW SUBGRADE

A. If conditions are encountered in excavations that result in an unsatisfactory sub grade, the Contractor shall notify the Owner. Whenever an excavation must be deepened due to unsatisfactory sub grade or a change in the plans, the Contractor shall perform said excavation when so directed by the Geotechnical Engineer. Soil measurements are to be taken by the Contractor under the direction of the Geotechnical Engineer to determine the additional excavation and backfill volume for Contract adjustment.

B. Except as modified above, sub grade, in the case of pipelines, shall be the bottom of the pipe trench as shown on the Contract Drawings. Excavation for pipe bells below barrel of pipe and pipe bedding shall not be classed as excavated below sub grade.

3.9. BACKFILLING

A. The Contractor shall backfill all excavation as rapidly as practicable after the completion of work therein or after the excavation has served their purpose. All unauthorized excavations made by the Contractor shall be immediately backfilled at the Contractor's cost.

B. No ash, refuse, large stones greater than 4 inches, or other material of an unsatisfactory character shall be used in backfilling and the Contractor shall not permit excavations to be used as a dumping ground for refuse.

C. Any material encountered during the excavation of any trench which will not consolidate over a reasonable period of time after being replaced in the trench shall be removed from the project site and replaced with material approved by the Geotechnical Engineer.

D. In backfilling trenches backfill shall be carefully placed by hand in 6-inch layers and solidly compacting under, around and over the pipe to a point at least one foot (1’) above the top of the pipe. Such compacting shall be done in a thorough manner with hand tampers made for the purpose and the greatest care shall be exercised so as not to disturb freshly made joints or the alignment of the pipe. The backfill shall be carried up and tamped evenly on both sides of the pipe. After the backfill material has reached the above mentioned height and has been tamped as specified the remainder of the trench may be filled by hand or by machinery at the option of the contractor.

E. All backfill material above the level of one foot over the top of the pipe shall be compacted in eight-inch (8”) layers to the following maximum density as determined by standard moisture density relationship test (ASTM D-698).

1. Top one-foot (1’) of trench below sub grade in paved areas — 100%

2. Trench and structure backfill — 95%

3. Non-structural (green) areas — 90%

F. After completion of backfilling all material not used therein, including such earth that cannot be properly rounded up over the refilled excavation, shall be removed and disposed of as the site shall be left free, clean and in good order. Said cleaning-up shall be done by the Contractor without extra compensation and if he shall fail to do such work within reasonable time after receipt of notice it will be performed by the Owner and the cost shall be retained out of the monies due or to become due to the Contractor under the Contract.

G. Refill and excavations other than in public rights of way shall be brought up to the original surface with excavated material and the surfaces restored to the condition existing prior to the beginning of work, and maintained as set forth in the following Section.

3.10. MAINTENANCE OF BACKFILL EXCAVATIONS

A. The Contractor shall maintain, at his own expense, all backfilled excavations in proper condition until the final surface materials replaced or until the end of the maintenance period whichever is later. All depressions appearing on the backfilled excavations shall be properly backfilled. If the Contractor shall fail to do so within twenty-four (24) hours after the receipt of backfill said depressions and the cost thereof shall be deducted from any monies due to become due the Contractor under the Contract. In case of emergency, the Owner may refill any dangerous depression without giving previous notice to the Contractor and the cost of so doing shall be retained from any monies due the Contractor.

B. The Contractor shall be responsible for any injury or damage that may result from improper maintenance of any backfilled excavation at any time previous to the end of the maintenance period.

3.11. FILL AND GRADING IN VICINITY OF PIPES AND STRUCTURES

A. Unless otherwise shown on plans or directed by the Owner, it is intended that surfaces in the vicinity of the work shall be left in their original condition. In certain locations, however, grading and filling of adjacent ground will be required as shown on the plans or as directed by the Owner. All suitable excess material from trenches and other excavations on the Contract shall be used first and the cost of placing this material shall be included in the prices bid for the various items under the Contract.

B. In the event that more material is needed to fill areas as shown on the plans the Contractor shall obtain borrow material from other sources. The obtaining of such borrow excavation shall be the Contractor’s responsibility. All borrow excavation shall be of satisfactory quality for the purpose for which it is required. The cost of placing and the cost of the material shall be included under the Contract.

C. All fills shall be placed in layers not thicker than eight inches and each layer shall be thoroughly compacted by rolling, tamping, or otherwise as directed to compaction requirements stated in these Specifications.

3.12. RESPONSIBILITY FOR CONDITIONS OF EXCAVATION

A. The Contractor shall be responsible for the condition of all excavations made by him. All slides and cave-ins shall be removed without extra compensation at whatever time and under whatever circumstances as they may occur.

3.13. PROTECTION OF PROPERTY AND STRUCTURES

A. The Contractor shall, at his own expense, sustain in their places and protect from direct or indirect injury all pipes, poles, tracks, walls, buildings and other structures or property in the vicinity of his work, whether above or below the ground or that may appear in the trench. He shall at all times have a sufficient quantity of timber and plank, chains, ropes, equipment and tools at the site of work and shall use them as necessary for sheeting his excavations and for sustaining or supporting any structures that are uncovered, undermined, endangered, threatened or weakened. The Contractor shall take all risks attending the presence of proximity of pipes, poles, tracks, walls, buildings and other structures and property of every kind and description in or over his trenches or in the vicinity of his work, whether above or below the surface of the ground. He shall be responsible for all damage and assume all expense for direct or indirect injury caused by his work to any of them, or to any person or property by reason of injury to them, whether such structures are or are not shown on the Drawings.

3.14. OBSTRUCTIONS SHOWN ON DRAWINGS

A. Certain information regarding the reputed presence, size, character and location of existing underground structures has been shown on the Contract Drawings. There is not certainty of the accuracy of this information and it shall be considered by the Contractor in this light. The locations of underground structures shown may be inaccurate and obstructions other than those shown may be encountered. The Contractor shall hereby distinctly understand that the Owner is not responsible for the correctness or sufficiently of the information given and he shall have no claim for delay or extra compensation on account of the insufficiency or absence of information regarding obstruction either revealed or not revealed by the Drawings.

B. The Contractor shall have no claim for relief from any obligation or responsibility under the Contract in other underground structure is not as indicated on the Drawings or in case any pipe or other underground structure is encountered that is not shown on the Drawings.

3.15. REMOVAL OF OBSTRUCTION

A. Should the position of any pipe, conduit or other underground structure be such as would require its removal, realignment or change due to work to be done under the Contract, the work or removal, realignment or change will be done by the Owner of the obstructions without cost to the Contractor unless otherwise noted in the Contract Drawings. The Contractor shall uncover and support such structures at his own expense before such removal and before and after such realignment or change as part of the Contract and the Contractor shall not be entitled to any claim for damages or extra compensation on account of the presence of said structure or on account of any delay in the removal or rearrangement of the same.

B. Public service poles coming within the line of the trench will be removed without expense to the Contractor. The Contractor shall provide proper notice to the involved utility companies.

C. The Contractor shall, if so directed by the Owner and without extra compensation, break through and reconstruct the invert or arch of any sewer, culvert or conduit that may be encountered if said structure is in such position that would require its removal, realignment, modification, or complete reconstruction.

D. The Contractor shall not interfere with any persons, firms, corporations, or the Owner, in protecting, removing changing or replacing their pipes, conduits, poles or the structures and he shall notify the Owner to take all such measures as they may deem necessary or advisable for the purpose aforesaid. The Contractor shall thereby be in no way relieved of any of his responsibility under the Contract.

3.16. PUBLIC UTILITIES

A. It shall be the duty of the Contractor to notify all public utilities having structure overhead or underground within the construction area one (1) week in advance of any operation. Any and all costs resulting from damage to such facilities, due to Contractor's operations, shall be borne by the Contractor.

END OF SECTION