Pantheon Theatre

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DOCUMENT 000101 - PROJECT TITLE PAGE

PROJECT MANUAL –

Vincennes Pantheon Theatre

428 Main Street
Vincennes, Indiana

Architect Project No. 15-02

Myszak+Palmer, Inc.
903 Broadway Street
Vincennes, Indiana 47591
Phone: 812.886.0350
Fax: 812.886.0790

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END OF DOCUMENT 000101

DOCUMENT 000115 - LIST OF DRAWING SHEETS

1.1 LIST OF DRAWINGS

A. Drawings: Drawings consist of the Contract Drawings and other drawings listed on the Table of Contents page of the separately bound drawing set titled River Pointe – Tell City, Indiana, New Senior Housing Project, dated September, 2014 as modified by subsequent Addenda and Contract modifications.

B. List of Drawings: Drawings consist of the following Contract Drawings and other drawings of type indicated:

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M.7	MECHANICAL SCHEDULES & DETAILS
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E.2	FIRST FLOOR ELECTRICAL/LIGHTING PLAN
E.3	SECOND FLOOR ELECTRICAL/LIGHTING PLAN
E.4	THIRD FLOOR ELECTRICAL/LIGHTING PLAN
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E.6	FIRST FLOOR ELEC. POWER/SYSTEM PLAN
E.7	SECOND FLOOR ELEC. POWER/SYSTEM PLAN
E.8	THIRD FLOOR ELEC. POWER/SYSTEM PLAN
E.9	ROOF LEVEL ELEC. POWER/SYSTEM PLAN
E.10	ELECTRICAL SCHEDULES & DETAILS
E.11	ELECTRICAL SCHEDULES & DETAILS
P.1	BASEMENT LEVEL PLBG. WATER DIST. PLAN
P.2	FIRST FLOOR PLBG. WATER DIST. PLAN
P.3	SECOND FLOOR PLBG. WATER DIST. PLAN
P.4	THIRD FLOOR PLBG. WATER DIST. PLAN
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DOCUMENT 001000 - INVITATION TO BID

Notice is hereby given that sealed bids in duplicate for the Pantheon Theatre Interior Renovation Project. The Pantheon Theater Building Project board will be prepared to receive sealed bids until 3:00 P.M. on Tuesday, February 19th 2019 at which time bids will be publicly opened. Sealed bids will be received at the Clerk Treasurers Office in City Hall at 201 Vigo Street, Vincennes, IN 47591.

Plans and Specifications:

Drawings & Specifications will be available on January 16TH 2019 and may be obtained from:

- Myszak + Palmer Office - 903 Broadway Street, Vincennes IN 47591 (812)-886-0350 (Download - $20 non-refundable fee)
- MACO -Evansville Blue - 600 Court Street, Evansville, IN 47708 (812) 464-8108 (Purchase)

Informalities: The Owner reserves the right to accept or reject any bid or waive any informality or errors in bidding.

Method of Bidding: Bid Package No.1- General Trades, Mechanical, Plumbing, Electrical, and Fire Sprinkler.

Pre-Bid Meeting: Thursday, January 17th 2019 at 1:00 P.M. EDT (Local Time). Attendance is not Mandatory but highly recommended.

Preparation and Submission of Bids: Bids shall be executed in accordance with the provided bid forms, a completed AIA Form G705 must be included stating “none” if there are to be no sub-contractors, and accompanied by a satisfactory bid bond, for not less than 5% of the total bid price. Contractor shall acknowledge all addenda on bid form.

Withdrawal of Bid: Should bidder withdraw his bid within 45 days date of opening without written consent of the Owner, the Owner may declare the bid deposit forfeited as liquidated damages.

Contract Security: Contractor receiving award shall furnish an approved Performance Bond in an amount of at least equal to 100% of the contract price and also a Labor and Material Payment Bond in an amount at least equal to 100% of the contract price or in a penal sum not less than that prescribed by law; as securities for the faithful performance of the contract and for the payment of all persons performing labor and furnishing materials on this project.

Plans and Specifications: Performance of the work shall be in accordance with plans and specifications on file at the following locations:

ARCHITECT
Myszak+Palmer, Inc.
903 Broadway Street
Vincennes, IN 47591

NOTICE TO BIDDERS

Notice is hereby given that the Pantheon Theater Building Project Board will receive sealed bids for the listed items. Said bids will be received until **3:00PM (local time) on Tuesday, February 19th 2019** at the Vincennes City Hall, Clerks Office, located at 201 Vigo Street at which time bids will be publicly opened.

Pantheon Theatre Interior Renovation Project

428 Main St. Vincennes, Indiana 47591

1. **Bid Package No.1-** General Trades, Mechanical, Plumbing, Electrical, and Fire Sprinkler.

Drawings & Specifications will be available on January 16th 2019 and may be obtained from:

- Myszak + Palmer Office - 903 Broadway Street, Vincennes IN 47591 (812)-886-0350 (Download - $20 non-refundable fee)
- MACO -Evansville Blue - 600 Court Street, Evansville, IN 47708 (812) 464-8108 (Purchase)

A voluntary pre-bid meeting will be held at the site at 1:00 P.M. EST on Thursday January 17th 2019. All bidders are encouraged to attend.

All bids must be submitted on Bid Forms provided.

Bid Security: Bidders shall include with their bid, a bid deposit in the amount of 5% of the total bid in form of a bank draft, certified check, money order, or bid bond.

After an award has been made to the successful bidder(s), the bid securities will be returned within thirty (30) days. The bid security of the lowest acceptable bidder will be returned on request after the Board has made an award to the successful bidder and if satisfactory Payment and Performance Bonds have been delivered to the owner.

The successful bidder will be required to furnish a satisfactory Payment and Performance Bond in the sum equal to the full amount of the Contract.

Pantheon Theater Building Project Board reserves the right to reject any or all bids presented and waives technicalities as to procedures and to award a contract on the bid that, in its judgement, is the most advantageous to the Pantheon Board.

Please advertise January 16, 2019 and January 23, 2019.

INSTRUCTIONS TO BIDDERS

GENERAL

A. Definitions and Communications

1. All definitions set forth in the General Conditions of the Contract for Construction, AIA Document A201 are applicable to these Instructions to Bidders.

2. All communications for the administration of the contract shall be as set forth in the General Conditions and, in general, shall be through the Architect.

B. Bidding Documents

1. The bidding documents are the bidding and contract requirements, the specifications, the drawings and any addenda issued prior to receipt of bids.

2. Documents are on file and may be examined or obtained for bidding purposes as stated in the Notice to Bidders.

3. Documents used for bidding purposes shall remain the property of the Architect, and shall be returned to the Architect as stated in the Notice to Bidders.

C Addenda During Bidding

1. Any additional information required by the bidders, revisions in the work, changes or additions, discrepancies in the bidding documents, or clarifications will be in the form of addenda written and issued by the Architect to all prime bidders of record as of the date of such addenda.

2. All addenda issued prior to the time and date set for termination of bidding shall become a part of the bidding documents and bidders shall list by number and date on the form of proposal, all addenda which have been received by him prior to submittal of his bid. The lump sum proposal amount shall include all work described by all such addenda. It shall be the bidder's responsibility to determine that he has received all addenda, since no extra costs will be allowed by failure of the bidder to do so.

3. Any bidder in doubt as to the true meaning of any part of the bidding documents may submit, no later than ten (10) days prior to the date set for receipt of bids, a written request to the Architect for an interpretation thereof. All interpretations of the bidding documents will be made by an addendum. No addendums will be issued less than three days prior to bid.

4. No oral, telephonic, telegraphic or fax instructions of information shall be

binding on the Owner, Architect, or bidder unless confirmed by an addendum.

D. Substitutions and Approvals During Bidding

1. Whenever products or materials are specified as "Standards" or they are otherwise named, approval of other equal quality products shall be obtained by requesting in writing and presenting for evaluation, such product or material, to the Architect, no later than ten (10) days prior to date set for receipt of bids. Submittals circumventing the above time frame will not be processed. Substitutions will be considered from Prime Bidders only.

   a. If approval is granted, product or material will be added by addendum.

   b. No direct reply will be made to any requests for changes, but any requested changes approved by the Architect will be stated in an addendum issued to all Prime Bidders.

   c. Issuance of bidding documents does not constitute approval of products, materials, or subcontractors.

2. Related requirements described elsewhere:

   a. Section 016000, "Product Requirements."

E. Bidder's Representation

1. Each bidder, by making his bid, represents that he has read and understands the bidding documents.

2. Each bidder, by making his bid, represents that he has visited the site and familiarized himself with the local conditions under which the work is to be performed.

   a. No additional costs of any type will be allowed by the failure of the bidder to avail himself of the privilege of a complete and thorough, on site inspection.

3. Each bidder, by making his bid, represents that he is properly licensed and has previous experience of the nature of the work he is bidding.

F. Bid Security

1. Provide bid security in the amount of five percent (5%) of bid, including all add alternates, made payable to the Owner. Security must be in the form of a Bid Bond AIA Document A310, and insurance company comparable form, or a certified check. Surety must be authorized to do business in the State of Indiana. Bid security shall be the bidder's guarantee that said

bidder will, if a contract is awarded to said bidder, execute within ten (10) days of acceptance of his bid, a contract for the work bid upon.

a. The bid securities **(certified checks only)** of all unsuccessful bidders will be returned promptly after an award has been made, or in the event that all bids are rejected. The bid security of the successful bidder will be returned when the contract is executed. If the successful Contractor refuses to enter into a Contract with the Owner he may have to forfeit his bid security.

G. Preparation of Bids

1. Bids shall be submitted in duplicate on the enclosed **provided bid forms.**

2. Bids shall be completely and correctly filled out using ink or typewriter, with signatures in ink.

   a. Prices shall be stated both in figures and in writing and in the event of a discrepancy between the writing and the figures, the written amount shall govern.

3. Bids shall be signed personally by the Bidder, by a partner or a duly authorized officer for a corporation, and shall give the bidder's business address and telephone number.

   a. Certified copies of resolutions or power of attorney authorizing the various individuals to sign the bid shall be enclosed with the bid.

4. Any interlineations, alteration, or erasure will be grounds for rejection of the bid. Bids shall contain no recapitulation of the work to be done.

5. Bids shall be based on the materials, construction, equipment and methods named or described in the specifications and on the drawings, and any addenda issued prior to receipt of bids.

6. Bids shall be accompanied by the following supplemental documents, all properly signed and notarized.

   a. Bid Security

7. All bidders shall submit to the Owner, on AIA Form G805, a complete list of subcontractors, furnishing and/or installing materials and products specified on this project. The list shall be complete with names, addresses, city, state and zip codes. Failure to complete this list may result in the rejection of the bid.

8. No oral, telephonic, telegraphic or fax bids will be accepted.

9. Submission of voluntary alternate may be grounds for rejection of bid.

H. Bid Submittal

1. Proposals shall be sealed in an opaque envelope marked with the bidder's name and business address, and bearing the following caption:

Proposal for: Pantheon Theatre Interior Renovation Project

a. Proposals shall be addressed and delivered to: the Clerks Office, at the Vincennes City Hall, 201 Vigo Street.

I. Modification of Bids

1. Modification of bids already submitted will be accepted by letter or telegram if received by the Owner prior to the date and hour set for receipt of bids.

J. Withdrawal of Bids

1. Bids may be withdrawn at any time prior to the scheduled time for receipt of bids.

a. Withdrawn bids may not be resubmitted.

b. Bids shall not be withdrawn for a period of sixty (60) days after the receipt of bids without the consent of the Owner.

K. Taxes, Permits, Inspections, Etc.

1. All bid amounts are not to include the cost of state and local taxes. The cost of all required permits and inspections as required by governing agencies shall be borne by the Contractor. The General Building Permit will be secured by the Contractor

L. Insurance

1. **Workers Compensation**: Statutory Limits as required by state of domicile. Employer's liability limits of $500,000 each accident, $500,000 disease each employee, $500,000 disease policy limit.
If Workers Compensation and employer's liability insurance is obtained through a self-insured fund, state government, or an association, a certificate of insurance must be issued to owner.

General Liability: Limit of $1,000,000 per occurrence and $2,000,000 general aggregate, including products and completed operations.

Property: If the contractor brings tools, equipment, or materials on the property, evidence of property coverage must be provided to the owner.

Automobile Liability: If Contractor brings automobiles, trucks, or any other equipment that moves over roads, owner must have evidence of automobile coverage with a minimum of $1,000,000 combined single limit

covering bodily injury and property damage, and coverage for uninsured and under insured motorist for owned, hired, and non-owned automobiles.

Umbrella Liability: A minimum limit of $1,000,000.

M. Non- Discrimination

Pursuant to IC-22-9-1-10 the contractor shall not discriminate against any employee or applicant for employment, to be employed in the performance of this contract.

N. Payment Bond

This project will require a Performance/Payment Bond per IC-36-1-12-13.1

O. Compliance with Indiana Code

All contractors shall comply with required Indiana Code requirements as required by the State of Indiana.

P. Notice of Award

Upon submittal of all required documentation a formal 'Notice of Award "shall be sent to the successful Bidder.

Q. Retainage

Retainage for this project shall be 5% until all work is satisfactorily completed.

R. Pre-Bid Meeting

A pre-bid meeting shall be held at the administrative building on January 17th 2019 at 1:00 P.M., local time, for all interested bidders. Attendance is not mandatory but highly recommended.

S. Liquidated Damages

Liquidated damages of $500.00 per calendar day may be assessed if construction is not complete by TBA.

SUPPLEMENTAL GENERAL CONDITIONS
AND SPECIAL CONDITIONS

1. CONTRACTOR'S AND SUBCONTRACTOR'S PUBLIC LIABILITY, VEHICLE LIABILITY AND PROPERTY DAMAGE INSURANCE

As required under Article 11 of the General Conditions, the Contractor's Public Liability Insurance and Vehicle Liability Insurance shall be in an amount not less than $1,000,000 for injuries, including accidental death, to any one person, in an amount not less than $1,000,000 on account of one accident, and Contractor's Property Damage Insurance in an amount not less than $1,000,000.

The Contractor shall either (1) require each of his subcontractors to procure and to maintain during the life of his subcontract, Subcontractor's Public Liability and Property Damage of the type and in the same amount as specified in the preceding paragraph, or (2) insure the activities of his subcontractors in his own policy.

2. BUILDERS RISK INSURANCE

Builders' Risk Insurance shall be provided by the Owner.

3. CONNECTION TO OTHER WORK

The contractor shall verify all utility companies' policies regarding meter installations., taps, etc. and shall be responsible for making all arrangements and scheduling of work in conjunction with said connection. They shall, unless otherwise noted, assume all costs arising for this connection, of their portion of said work.

4. PREPARATION OF WORK

The Owner does not in any way agree to prepare the building or site for the reception of the Contractor's work further than is specifically mentioned in the Specifications. Each Contractor shall bear full responsibility for the expense of cutting, repairing, excavating, backfilling, etc., necessary for installing the work on the premises or in the cutting, fitting, and patching required in attaching it to the same, except in circumstances as may be provided in the Contract Documents.

5. PROTECTION OF WORK

Each Contractor shall assume full responsibility for protection of his work until acceptance by the Owner. He shall also take all precautions to prevent damage to existing equipment, property or structures which might be caused by him. In cases where items are damaged, removed, or disturbed by the Contractor, they shall be replaced, repaired, or compensated for in a manner approved by the Architect.

6. QUALITY OF MATERIAL

All material shall be new unless specified or noted otherwise.

7. SAFETY

The General Contractor shall be responsible in enforcing safety precautions and shall provide all barricades, signs, lights, and other necessary safeguards.

8. ESSENTIAL ITEMS

Should an item that is essential to the intent of the Contract be omitted from the Plans and Specifications, it shall be called to the Architect/Engineer's attention prior to submission of the Contractor's bid. Failure to do so shall not relieve the Contractor from fulfilling the intent of the Contract.

9. CONFLICTS AND DISCREPANCIES

Should any discrepancies, omissions, ambiguities, or conflicts be discovered, they shall be brought to the attention of the Architect/Engineer for interpretation or clarification. Unless otherwise clarified, the larger quantity and/or better-quality material shall be furnished.

It is the intent of the Contract Documents (plans, specifications, general conditions, special and supplemental conditions, addenda, etc.) that all individual elements of said documents are to be used to the collective end that a beneficial project shall be constructed for the Owner. No one individual part or section of the Contract documents shall have controlling authority over the others. All interpretations shall be made by the Architect/Engineer.

10. SUBSTITUTION

Should a substitution of equipment or material be desired by the Contractor, he must receive written approval 10 days prior to bidding from the Architect. He shall be held responsible for the completeness of the equipment, its proper fit in available space, and any change required in other contracts.

12. WARRANTIES

Each bidder is hereby notified that upon being awarded a construction contract, the Contractor shall provide to the Owner in writing, a one-year warranty on **all** materials and labor. The one-year warranty term shall begin with the date of established substantial completion.

Any product warranty extending beyond this period shall be honored by the Contractor. Contractor shall provide the labor required to install such products for the duration of the product warranty.

13. Americans with Disabilities Act

The Americans with Disabilities Act (ADA) (42 U.S.C. 12101] et. seq.) and the regulations thereunder (28 CFR 35.130) prohibit discrimination against persons with disabilities by the State, whether directly or through contractual arrangements, in the provisions of any aid, benefit or service.

14. Lien Waiver

Construction shall be monitored to assure that necessary contractor's affidavits and waivers of mechanics liens are obtained prior to release of funds to contractors and subcontractors.

DOCUMENT 002214 - SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

1.1 INSTRUCTIONS TO BIDDERS

A. Instructions to Bidders for Project consist of the following:

1. Specification Section 002113, "Instructions to Bidders"
2. The following Supplementary Instructions to Bidders that modify and add to the requirements of the Instructions to Bidders.

1.2 SUPPLEMENTARY INSTRUCTIONS TO BIDDERS, GENERAL

A. The following supplements modify AIA Document A701, "Instructions to Bidders." Where a portion of the Instructions to Bidders is modified or deleted by these Supplementary Instructions to Bidders, unaltered portions of the Instructions to Bidders shall remain in effect.

1.3 ARTICLE 2 - BIDDER'S REPRESENTATIONS

A. Add Section 2.1.3.1:

1. 2.1.3.1 - The Bidder has investigated all required fees, permits, and regulatory requirements of authorities having jurisdiction and has properly included in the submitted bid the cost of such fees, permits, and requirements not otherwise indicated as provided by Owner.

B. Add Section 2.1.5:

1. 2.1.5 - The Bidder is a properly licensed Contractor according to the laws and regulations of the State of Indiana /County of Knox and meets qualifications indicated in the Procurement and Contracting Documents.

C. Add Section 2.1.6:

1. 2.1.6 - The Bidder has incorporated into the Bid adequate sums for work performed by installers whose qualifications meet those indicated in the Procurement and Contracting Documents.

1.4 ARTICLE 3 - BIDDING DOCUMENTS

A. 3.2 - Interpretation or Correction of Procurement and Contracting Documents:

1. Add Section 3.2.2.1:

a. 3.2.2.1 - Submit Bidder's Requests for Interpretation using Architect’s Form M+P13.2A, which is bound to Project Manual..

B. 3.4 - Addenda:

1. Delete Section 3.4.3 and replace with the following:

   a. 3.4.3 - Addenda may be issued at any time prior to the receipt of bids.

2. Add Section 3.4.4.1:

   a. 3.4.4.1 - Owner may elect to waive the requirement for acknowledging receipt of 3.4.4 Addenda as follows:

      1) 3.4.4.1.1 - Information received as part of the Bid indicates that the Bid, as submitted, reflects modifications to the Procurement and Contracting Documents included in an unacknowledged Addendum.
      2) 3.4.4.1.2 - Modifications to the Procurement and Contracting Documents in an unacknowledged Addendum do not, in the opinion of Owner, affect the Contract Sum or Contract Time.

1.5 ARTICLE 4 - BIDDING PROCEDURES

A. 4.1 - Preparation of Bids:

1. Add Section 4.1.1.1:

   a. 4.1.1.1 - Printable electronic Bid Forms and related documents are available from Architect with purchase of electronic pdf project files.

2. Add Section 4.1.9:

   a. 4.1.9 - Owner may elect to disqualify a bid due to failure to submit a bid in the form requested, failure to bid requested alternates or unit prices, failure to complete entries in all blanks in the Bid Form, or inclusion by the Bidder of any alternates, conditions, limitations or provisions not called for.

B. 4.3 - Submission of Bids:

1. Add Section 4.3.1.2:

   a. 4.3.1.2 - Include Bidder's Contractor License Number applicable in Project jurisdiction on the face of the sealed bid envelope.

C. 4.4 - Modification or Withdrawal of Bids:

1. Add the following sections to 4.4.2:

   a. 4.4.2.1 - Such modifications to or withdrawal of a bid may only be made by persons authorized to act on behalf of the Bidder. Authorized persons are those so identified in the Bidder's corporate bylaws, specifically empowered by the Bidder's charter or similar legally binding document acceptable to Owner, or by a power of attorney, signed and dated, describing the scope and limitations of the power of attorney. Make such documentation available to Owner at the time of seeking modifications or withdrawal of the Bid.

b. 4.4.2.2 - Owner will consider modifications to a bid written on the sealed bid envelope by authorized persons when such modifications comply with the following: the modification is indicated by a percent or stated amount to be added to or deducted from the Bid; the amount of the Bid itself is not made known by the modification; a signature of the authorized person, along with the time and date of the modification, accompanies the modification. Completion of an unsealed bid form, awaiting final figures from the Bidder, does not require power of attorney due to the evidenced authorization of the Bidder implied by the circumstance of the completion and delivery of the Bid.

D. 4.5 - Break-Out Pricing Bid Supplement:

1. Add Section 4.5:

a. 4.5 - Provide detailed cost breakdowns no later than two business days following Architect's request.

E. 4.6 - Subcontractors, Suppliers, and Manufacturers List Bid Supplement:

1. Add Section 4.6:

a. 4.6 - Provide list of major subcontractors, suppliers, and manufacturers furnishing or installing products on AIA G705 attached to Project Manual with Bid. Include those subcontractors, suppliers, and manufacturers providing work totaling three percent or more of the Bid amount. Do not change subcontractors, suppliers, and manufacturers from those submitted without approval of Architect.

1.6 ARTICLE 5 - CONSIDERATION OF BIDS

A. 5.2 - Rejection of Bids:

1. Add Section 5.2.1:

a. 5.2.1 - Owner reserves the right to reject a bid based on Owner's and Architect's evaluation of qualification information submitted following opening of bids. Owner's evaluation of the Bidder's qualifications will include: status of licensure and record of compliance with licensing requirements, record of quality of completed work, record of Project completion and ability to complete, record of financial management including financial resources available to complete Project and record of timely payment of obligations, record of Project site management including compliance with requirements of authorities having jurisdiction, record of and number of current claims and disputes and the status of their resolution, and qualifications of the Bidder's proposed Project staff and proposed subcontractors.

1.7 ARTICLE 6 - POSTBID INFORMATION

A. 6.1 - Contractor's Qualification Statement:

1. Add Section 6.1.1:

   a. 6.1.1 - Submit Contractor's Qualification Statement no later than two business days following Architect's request.

B. 6.3 - Submittals:

1. Add Section 6.3.1.4:

   a. 6.3.1.4 - Submit information requested in Sections 6.3.1.1, 6.3.1.2, and 6.3.1.3 no later than two business days following Architect's request.

1.8 ARTICLE 7 - PERFORMANCE BOND AND PAYMENT BOND

A. 7.1 - Bond Requirements:

1. Add Section 7.1.1.1:

   a. 7.1.1.1 - Both a Performance Bond and a Payment Bond will be required, each in an amount equal to 100 percent of the Contract Sum.

B. 7.2 - Time of Delivery and Form of Bonds:

1. Delete the first sentence of Section 7.2.1 and insert the following:

   a. The Bidder shall deliver the required bonds to Owner no later than 10 days after the date of Notice of Intent to Award and no later than the date of execution of the Contract, whichever occurs first. Owner may deem the failure of the Bidder to deliver required bonds within the period of time allowed a default.

2. Delete Section 7.2.3 and insert the following:

   a. 7.2.3 - Bonds shall be executed and be in force on the date of the execution of the Contract.

1.9 ARTICLE 9 - EXECUTION OF THE CONTRACT

1. Add Article 9:

   a. 9.1.1 - Subsequent to the Notice of Intent to Award, and within 10 days after the prescribed Form of Agreement is presented to the Awardee for signature, the Awardee shall execute and deliver the Agreement to Owner, in such number of counterparts as Owner may require.
   b. 9.1.2 - Owner may deem as a default the failure of the Awardee to execute the Contract and to supply the required bonds when the Agreement is presented for signature within the period of time allowed.
   c. 9.1.3 - Unless otherwise indicated in the Procurement and Contracting Documents or the executed Agreement, the date of commencement of the Work shall be the date of the executed Agreement or the date that the

Bidder is obligated to deliver the executed Agreement and required bonds to Owner.

d. 9.1.4 - In the event of a default, Owner may declare the amount of the Bid security forfeited and elect to either award the Contract to the next responsible bidder or re-bid.

2.0 CONTRACTOR'S LIABILITY INSURANCE

A. Each Contractor shall take out and maintain insurance of such types and in such amounts as are necessary to cover his responsibilities and liabilities on a project of the character contemplated under this contract, and shall require all his subcontractors to carry similar insurance.

B. No Contractor shall commence work under this contract until he has obtained all insurance required unless this Section and such insurance has been approved by the Owner, nor shall any Contractor allow any subcontractor to commence work on his subcontract until the same insurance has been obtained by the subcontractor and approved by the Owner.

C. Each Contractor shall file with the Owner and Architect, prior to the commencement of work, a Certificate of Insurance. Any certificate submitted and found to be altered or incomplete will be returned as unsatisfactory.

D. If requested by the Owner, Contractor shall furnish the Owner with true copies of each policy required of him or his subcontractors. Said policies will not be cancelled or materially altered, except after thirty (30) days advance written notice to the Owner and Architect, mailed to the addresses indicated herein.

E. Insurance under this Section, as a minimum, shall include the following coverages:

1. Workmen's Compensation and Employer's Liability Insurance:

   Workmen's Compensation and Occupational Disease insurance of statutory limits as provided by the state in which this contract is performed and Employers' Liability Insurance at a limit of not less than $100,000.00 for all damages arising from each accident or occupational disease per person and $500,000.00 annual aggregate.

2. Commercial General Liability Insurance in which the Architect and the Owner are named as additional insured covering:

   a. Operations – Premises Liability:

      Including, but not limited to, Bodily Injury, including death at any time resulting therefrom, to any person or Property Damage resulting from execution of the work provided for in this contract, or due to or arising in any manner from any act or omission or negligence of the Contractor and any subcontractor, their respective employees or agents.

   b. Contractor's Protective Liability:

Including, but not limited to, Bodily Injury, including death at any time resulting therefrom, to any person or Property Damage arising from acts or omissions of any subcontractor, their employees or agents.

c. Products – Completed Operations Liability:

Including, but not limited to, Bodily Injury, including death at any time resulting therefrom, to any person or Property Damage because of goods, products, materials or equipment used or installed under this contract, or because of completed operations, which may become evident within one (1) year after acceptance of the building including damage to the building or its contents.

d. Contractual Liability:

Each and every policy for liability insurance, carried by each Contractor and subcontractor, as required by this Section shall specifically include Contractual Liability coverage.

e. Special Requirements:

The insurance required under Paragraph 2 of this subsection shall specifically include the following special hazards:

Property Damage caused by conditions otherwise subject to exclusions "x,c,u", Explosion, Collapse or Underground Damage.

Broad Form Property Damage endorsement, which has reference to property in the "care, custody, or control" of the insured.

Aggregate limits must apply per project.

"Occurrence" Property Damage coverage in lieu of "caused by accident".

f. Limits of Liability:

The insurance under Paragraph 2 of the subsection shall be written in the following limits of liability, as a minimum:

For Contracts less than $250,000.00:

Bodily Injury and Property Damage:

$500,000.00	Each Occurrence
$1,000,000.00	Aggregate Projects and Completed Operations
$1,000,000.00	General Aggregate

For Contracts $250,000.00 or Greater:

Bodily Injury and Property Damage:

$1,000,000.00	Each Occurrence

$2,000,000.00	Aggregate Projects and Completed Operations
$2,000,000.00	General Aggregate

3. Comprehensive Automobile Liability covering:

   a. All owned, hired, or non-owner vehicles including the loading or unloading thereof.

   b. Limits of Liability:

      The insurance under Paragraph 3 of this subsection shall be written in the following limits of liability as a minimum:

For Contracts Less than $250,000.00:

Automobile Bodily Injury	
Each Person	$250,000.00
Each Occurrence	$500,000.00
Automobile Property Damage	
Each Occurrence	$100,000.00
Or Combined Single Limit	$500,000.00

For Contracts $250,000.00 or greater:

Automobile Bodily Injury	
Each Person	$500,000.00
Each Occurrence	$1,000,000.00
Automobile Property Damage	
Each Occurrence	$250,000.00
Or Combined Single Limit	$1,000,000.00

4. Umbrella Liability:

Each Occurrence and Aggregate	$1,000,000.00

F. Hold Harmless Agreement

1. The Contractor shall indemnify and hold harmless the Owner and the Architect and their agents and employees from and against all claims, damages, losses and expenses including attorney's fees arising out of or resulting from the performance of the work, provided that any such claim, damage, loss or expense (a) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (including but not limited to the work) including the loss of use resulting therefrom, and (b) is caused in whole or in part by any negligent act or omission of the Contractor, any subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder.

2. In any and all claims against the Owner or the Architect or any of their agents or employees by an employee of the Contractor, Subcontractor, anyone directly or indirectly employed by any of them or anyone for those acts any of them may be liable, the indemnification obligation under this Hold Harmless Agreement shall not be limited in any way by any limitation on the amount payable by or for the Contractor or any Subcontractor under workmen's compensation acts, disability benefit acts or other employee benefit acts.

3. The obligations of the Contractor under this Hold Harmless Agreement shall not extend to any claim, damage, loss or expense for which the Architect is legally liable arising out of professional services performed by the Architect, his agents, or employees, including (a) the preparation of maps, plans, opinions, reports, surveys, designs or specifications, and (b) periodic observation of the work or engineering services.

2.1 BROAD FORM BUILDERS RISK COMPLETED VALUE INSURANCE

A. The Owner will effect and maintain Broad Form Builders Risk Completed Value Insurance or an equivalent coverage covering all risks of physical loss. This insurance is to be upon all the structures on which the work of all the Contracts is to be done to one hundred percent (100%) of the insurable value thereof, including items of labor and materials connected therewith whether in or adjacent to the structures insured, materials in place or to be used as part of the permanent construction including surplus materials, shanties, protective fences, bridges, temporary structures, miscellaneous materials and supplies incident to the work, and such scaffoldings, staging, towers, and equipment as are not owned or rented by the Contractor, the cost of which is included in the cost of the work. EXCLUSIONS: This insurance does not cover any tools owned by mechanics any tools, equipment, scaffolding, staging, towers, and forms owned or rented by the Contractor, the capital value of which is not included in the cost of the work, or any structures erected for housing of food service for the workmen.

B. Said insurance, to be furnished by the Owner, shall insure the Owner's interest, shall insure the interest of all Contractors having a contract with the Owner, and shall also include all Subcontractors of each Contractor. The Contractors shall be named or designated in such capacity as insured jointly with the Owner in all policies and all Subcontractors for each Contractor shall be included as insured jointly with the Contractors in all policies by designation, by name, o each of said Subcontractors, or by designation, "Subcontractors, as their respective interest may appear." Certificates of such insurance shall be filed with each of the Contractors and the Architect. If the Owner fails to effect or maintain insurance as above and so notifies the Contractor, the Contractor may insure his own interest and that of the subcontractors and charge the cost thereof to the Owner. If the Contractor is damaged by failure of the Owner to maintain such insurance or to so notify the Contractor he may recover as stipulated in the Contract for recovery of damages. If other special insurance not herein provided for is required by the Contractor, the Owner shall effect such insurance at the Contractor's expense by appropriate riders to his Builders Risk Insurance policy. The Owner, Contractors, and all subcontractors waive all rights, each against the other, for damages caused by fire or other perils covered by insurance provided under the terms of this article, except such rights as they may have to the proceeds of insurance held by the Owner as Trustee.

C. The loss, if any, is to be made adjustable with and payable to the Owner as Trustee for the insured and Contractors and subcontractors as their interest may appear, except in such cases as may require payment of all or a portion of said insurance to be made to a mortgagee as his interest may appear.

D. The Owner shall be responsible for and at his option may insure against loss of use of his existing property, due to fire or otherwise, however caused. If required in writing by any party in interest, The Owner as Trustee shall, upon the occurrence of loss, give bond for the proper performance of his duties. He shall deposit any money received from insurance in an account separate from all his other funds and he shall distribute it in accordance with such agreement as the parties in interest may reach. If after loss no special agreement is made, replacement of injured work shall be ordered and executed as provided under Article 7.

E. The Trustee shall have power to adjust and settle any loss with the insurers unless one of the Contractors interested shall object in writing within three (3) working days of the occurrence of loss.

END OF DOCUMENT 002213

BID FORM FOR LUMP SUM CONTRACTS

Proposal of_____
(hereinafter called the "Bidder"), a corporation organized and existing under the laws of the State of _____, a partnership, or an individual doing business as _____ _____ (cross out two of the above) to Pantheon Theatre. (hereinafter called the "Owner").

TO: Pantheon Theatre

The Bidder, in compliance with your invitation for bids for the Pantheon Theatre, having examined the plans and specifications with related documents and the site of the proposed work, and being familiar with all of the conditions surrounding the construction of the proposed project, including the availability of materials and labor, hereby proposes to furnish all labor, materials, supplies, and supervision, and to set forth therein, and at the prices stated below. These prices are to cover all expenses incurred in performing the work required under the Contract Documents, of which this proposal is a part.

Bidder acknowledges receipt of the following addenda:

Addendum No.	Date
_____	_____
_____	_____
_____	_____
_____	_____

Bidder understands that the Owner reserves the right to reject any or all bids and to waive any informalities in bidding.

The bidder agrees that this bid shall be good and may not be withdrawn for a period of 60 calendar days after the scheduled closing time for receiving bids.

Upon receipt of written notice of the acceptance of this bid, Bidder will execute the final contract attached within 10 days.

The Contractor, and Subcontractors, if any, shall not discriminate against any employee, or applicant for employment, or any matter directly or indirectly related to employment, because of race, color, religion, sex, age, national origin or ancestry. Breach of this covenant may be regarded as a material breach of the contract.

All Subcontractors are subject to the approval of the Owner. Contractors must fill out completely the List of Subcontractors (AIA Form G705) included herein. Failure to submit this list may be cause for rejection of the bidder's proposal.

Respectfully submitted by:

_____
(Signature & Title)

_____
(Company Name)

_____

_____
(Address)

(Corporate Seal)

BID FORM FOR COMPLETE CONSTRUCTION

Bidder agrees to furnish all labor and materials as per plans, specifications, and related documents. Base bid to include all site work, general construction, mechanical, and electrical construction.

FOR THE SUM OF

_____
_____DOLLARS
($_____)

NOTE: General Contractor must include form G805 "list of Subcontractors" with this bid form, or bid may be rejected.

DOCUMENT 004323 - ALTERNATES FORM

1.1 BID INFORMATION

A. Bidder: _____.

B. Prime Contract: _____.

C. Project Name: Pantheon Theatre

D. Project Location: 428 Main Street, Vincennes, Indiana 47591

E. Owner:

F. Architect: Myszak + Palmer Architects

G. Architect Project Number: 15-02

1.2 BID FORM SUPPLEMENT

A. This form is required to be attached to the Bid Form.

1.3 DESCRIPTION

A. The undersigned Bidder proposes the amount below be added to or deducted from the Base Bid if particular alternates are accepted by Owner. Amounts listed for each alternate include costs of related coordination, modification, or adjustment.

B. If the alternate does not affect the Contract Sum, the Bidder shall indicate "NO CHANGE."

C. If the alternate does not affect the Work of this Contract, the Bidder shall indicate "NOT APPLICABLE."

D. The Bidder shall be responsible for determining from the Contract Documents the affects of each alternate on the Contract Time and the Contract Sum.

E. Owner reserves the right to accept or reject any alternate, in any order, and to award or amend the Contract accordingly within 60 days of the Notice of Award unless otherwise indicated in the Contract Documents.

F. Acceptance or non-acceptance of any alternates by the Owner shall have no affect on the Contract Time.

1.4 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Demolition and install of new exterior doors and windows. (See sheets A3.1 - A3.6)
   1. _____ Dollars ($_____).

1.5 SUBMISSION OF BID SUPPLEMENT

Respectfully submitted this ____ day of _____, 2019.

Submitted By: _____

(Name of bidding firm or corporation)

Authorized Signature: _____

(Handwritten signature)

Signed By: _____

(Type or print name)

Title: _____

(Owner/Partner/President/Vice President)

END OF DOCUMENT 004323

GENERAL CONDITIONS

I. GENERAL

A. Description

1. The General Conditions for this project are the “General Conditions of the Contract for Construction”, AIA Document A201, 2007 Edition. A copy of which is included by reference.

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. Project: Pantheon Theater Interior Renovation Project

B. Owner: The City of Vincennes, Indiana

C. Architect: Myszak+Palmer, Inc.

D. The Work consists of: Renovations to the interior of the existing building.

E. Contractor's Use of Premises: During construction, Contractor will have full use of site indicated. Contractor's use of premises is limited only by Owner's right to perform work or employ other contractors on portions of Project.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 011000

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:
   1. Contingency allowances.

C. Related Requirements:
   1. Division 01 Section "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.

1.2 SELECTION AND PURCHASE

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

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

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

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

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

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

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

1.5 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.6 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, insurance, equipment rental, and similar costs.

C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.

D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.7 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
   1. Include installation costs in purchase amount only where indicated as part of the allowance.
   2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
   3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
   4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
   1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
   2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Contract #1 for General Construction; Contingency Allowance: Include the sum of $50,000.00
   1. This allowance includes material cost receiving, handling, and installation and Contractor overhead and profit.

END OF SECTION 012100

Alternate Bid No. 1 (ADD)

Demolition and install of new exterior doors and windows. (See sheets A3.1 - A3.6)

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:

C.
1. Section 016000 "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.

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 M+P Form 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 cannot be provided, if applicable.
   b. Coordination 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 substitution 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 and 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 substitution 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. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven (7) days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within fifteen (15) days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.

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

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than fifteen (15) days prior to time required for preparation and review of related submittals.
   1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
      a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
      b. Requested substitution provides sustainable design characteristics that specified product provided.
      c. Substitution request is fully documented and properly submitted.
      d. Requested substitution will not adversely affect Contractor's construction schedule.
      e. Requested substitution has received necessary approvals of authorities having jurisdiction.
      f. Requested substitution is compatible with other portions of the Work.
      g. Requested substitution has been coordinated with other portions of the Work.
      h. Requested substitution provides specified warranty.
      i. 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, unless approved by Architect.

C. Substitutions for Convenience: Architect will consider requests for substitution if received within sixty (60) days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
   1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
      a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.

b. Requested substitution does not require extensive revisions to the Contract Documents.
c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
d. Requested substitution provides sustainable design characteristics that specified product provided.
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 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:
   1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions." form.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
   1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
   2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
      a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
      b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      c. Include costs of labor and supervision directly attributable to the change.
      d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity

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

e. Quotation Form: Use AIA G709 “Work Changes Proposal Request”.

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

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use AIA G709“Work Changes Proposal Request”.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701, form included in Project Manual.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714, form included in Project Manual. 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 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule
   1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
      a. Application for Payment forms with continuation sheets.
      b. Submittal schedule.
      c. Items required to be indicated as separate activities in Contractor's construction schedule.
   2. Submit the schedule of values to Architect at earliest possible date, but no later than seven (7) days before the date scheduled for submittal of initial Applications for Payment.
   3. Sub schedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide sub schedules showing values coordinated with each element.
   4. Sub schedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide sub schedules showing values coordinated with the scope of each design services contract as described in Section 011000 "Summary."

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one-line item for each Specification Section.
   1. Identification: Include the following Project identification on the schedule of values:
      a. Project name and location.
      b. Name of Architect.
      c. Architect's project number.
      d. Contractor's name and address.
      e. Date of submittal.
   2. Arrange schedule of values consistent with format of AIA Document G703.
   3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
      a. Related Specification Section or Division.
      b. Description of the Work.
      c. Name of subcontractor.
      d. Name of manufacturer or fabricator.
      e. Name of supplier.
      f. Change Orders (numbers) that affect value.
      g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
         1) Labor.
         2) Materials.
         3) Equipment.
   4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five (5) percent of the Contract Sum.
      a. Include separate line items under Contractor and subcontracts Project closeout requirements in an amount totaling five (5) percent of the Contract Sum and subcontract amount.
   5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
   6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
      a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
   7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
   8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
   9. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
   10. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

11. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
   1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Times: Submit Application for Payment to Architect by the first day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
   1. Submit draft copy of Application for Payment seven (7) days prior to due date for review by Architect.

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

E. Application for Payment Forms: Use forms provided by Owner for Applications for Payment.

F. Application for Payment Forms: Use forms acceptable to Architect and Owner for Applications for Payment. Submit forms for approval with initial submittal of schedule of values.

G. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
   1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
   2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
   3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
   4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

H. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
   1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
   2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
   3. Provide summary documentation for stored materials indicating the following:
      a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
      b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
      c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

I. Transmittal: Submit three (3) signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
   1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

J. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
   1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
   2. When an application shows completion of an item, submit conditional final or full waivers.
   3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
   4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

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

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

2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Products list (preliminary if not final).
5. Schedule of unit prices.
6. Submittal schedule (preliminary if not final).
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Copies of building permits.
10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
11. Initial progress report.
12. Report of preconstruction conference.
13. Certificates of insurance and insurance policies.
14. Performance and payment bonds.
15. Data needed to acquire Owner's insurance.

M. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

N. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013000 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 PROJECT MANAGEMENT AND COORDINATION

A. Subcontract List: Submit a written summary identifying individuals or firms proposed for each portion of the Work.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. List e-mail addresses and telephone numbers.

C. Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work.

D. Requests for Information (RFIs): On discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI. Use AIA Document G716.

E. Schedule and conduct progress meetings at Project site at monthly or other indicated regular intervals intervals. Notify Owner and Architect of meeting dates and times. Require attendance of each subcontractor or other entity concerned with current progress or involved in planning, coordination, or performance of future activities.

1. Construction Manager will Record minutes and distribute to everyone concerned, including Owner and Architect.

1.2 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings, upon request, may be provided by Architect for Contractor's use in preparing submittals.

1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.

a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

B. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

1. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

2. Submit three copies of each action submittal. Architect will return two copies.
3. Submit two copies of each informational submittal. Architect will not return copies.
4. Architect will discard submittals received from sources other than Contractor.

C. Paper Submittals: Place a permanent label or title block on each submittal for identification. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect. Include the following information on the label:

1. Project name.
2. Date.
3. Name and address of Contractor.
4. Name and address of subcontractor or supplier.
5. Number and title of appropriate Specification Section.

D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with unique identifier, including project identifier, Specification Section number, and revision identifier.
3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.

E. Identify options requiring selection by Architect.

F. Identify deviations from the Contract Documents on submittals.

G. Contractor's Construction Schedule Submittal Procedure:

1. Submit required submittals in the following format:

   a. Working electronic copy of schedule file, where indicated.
   b. PDF electronic file.
   c. Two paper copies.

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

   a. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

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

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections.

1. Post electronic submittals as PDF electronic files directly to architect at jpalmer@myszakpalmer.com.

a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. Submit electronic submittals via email as PDF electronic files.

a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2.2 ACTION SUBMITTALS

A. Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.

B. Product Data: Mark each copy to show applicable products and options. Include the following:

1. Manufacturer's written recommendations, product specifications, and installation instructions.
2. Wiring diagrams showing factory-installed wiring.
3. Printed performance curves and operational range diagrams.
4. Testing by recognized testing agency.
5. Compliance with specified standards and requirements.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data. Submit on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 42 inches (762 by 1067 mm). Include the following:

1. Dimensions and identification of products.
2. Fabrication and installation drawings and roughing-in and setting diagrams.
3. Wiring diagrams showing field-installed wiring.
4. Notation of coordination requirements.
5. Notation of dimensions established by field measurement.

D. Samples: Submit Samples for review of kind, color, pattern, and texture and for a comparison of these characteristics between submittal and actual component as delivered and installed. Include name of manufacturer and product name on label.

1. If variation is inherent in material or product, submit at least three sets of paired units that show variations.

2.3 INFORMATIONAL SUBMITTALS

A. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.

B. Qualification Data: Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

C. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

2.4 DELEGATED DESIGN SERVICES

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

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

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of 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.

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

2.5 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type schedule within 30 days of date established for the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

C. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

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

PART 3 - EXECUTION

3.1 SUBMITTAL REVIEW

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

B. Architect will review each action submittal, make marks to indicate corrections or modifications required, will stamp each submittal with an action stamp, and will mark stamp appropriately to indicate action.

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

D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

3.2 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Updating: At monthly intervals, or as Architect deems necessary to maintain owner’s schedule, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribute copies of approved schedule to Owner, Architect, subcontractors, testing and inspecting agencies, and parties identified by Contractor with a need-to-know schedule

responsibility. When revisions are made, distribute updated schedules to the same parties.

END OF SECTION 013000

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:
   1. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
   2. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
   3. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
   4. Division 01 Section "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.3 ACTION SUBMITTALS

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

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic copies of digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals at Contractor’s request..
   1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings if so requested by Contractor for use in preparing Shop Drawings and Project record drawings.

a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
b. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.
c. Architect will provide this document if necessary. A copy of AIA C106 is included in this project manual.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 7 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 7 days for review of each resubmittal.

D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information for processing and recording action taken:
a. Project name.
b. Date.
c. Name of Architect.
d. Name of Contractor.
e. Name of subcontractor.
f. Name of supplier.
g. Name of manufacturer.
h. Submittal number or other unique identifier, including revision identifier.
1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
i. Number and title of appropriate Specification Section.
j. Drawing number and detail references, as appropriate.
k. Location(s) where product is to be installed, as appropriate.
l. Other necessary identification.

4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
   a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.
   a. Transmittal Form for Paper Submittals: Use AIA Document G810. A copy of the G810 has been included in this project manual.
   b. Transmittal Form for Paper Submittals: Provide locations on form for the following information:
      1) Project name.
      2) Date.
      3) Destination (To:).
      4) Source (From:).
      5) Name and address of Architect.
      6) Name of Contractor.
      7) Name of firm or entity that prepared submittal.
      8) Names of subcontractor, manufacturer, and supplier.
      9) Category and type of submittal.
      10) Submittal purpose and description.
      11) Specification Section number and title.
      12) Specification paragraph number or drawing designation and generic name for each of multiple items.
      13) Drawing number and detail references, as appropriate.
      14) Indication of full or partial submittal.
      15) Transmittal number, numbered consecutively.
      16) Submittal and transmittal distribution record.
      17) Remarks.
      18) Signature of transmitter.

E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
   1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
   2. Name file with submittal number or other unique identifier, including revision identifier.
      a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
   3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
   4. Transmittal Form for Electronic Submittals: Use Adobe PDF documents acceptable to Owner. Documents shall be emailed to amsyzak@myszakpalmer.com and cjordan@myszakpalmer.com and contain the following information:
      a. Project name.

b. Date.
c. Name and address of Architect.
d. Name of Contractor.
e. Name of firm or entity that prepared submittal.
f. Names of subcontractor, manufacturer, and supplier.
g. Category and type of submittal.
h. Submittal purpose and description.
i. Specification Section number and title.
j. Specification paragraph number or drawing designation and generic name for each of multiple items.
k. Drawing number and detail references, as appropriate.
l. Location(s) where product is to be installed, as appropriate.
m. Related physical samples submitted directly.
n. Indication of full or partial submittal.
o. Transmittal number, numbered consecutively.
p. Submittal and transmittal distribution record.
q. Other necessary identification.
r. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
   a. Project name.
   b. Number and title of appropriate Specification Section.
   c. Manufacturer name.
   d. Product name.
   e.

F. Options: Identify options requiring selection by Architect.

G. Deviations: Identify deviations from the Contract Documents on submittals.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
   1. Note date and content of previous submittal.
   2. Note date and content of revision in label or title block and clearly indicate extent of revision.
   3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

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

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

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements:
1. Post electronic submittals as PDF electronic files directly to Project Web site (Architect's FTP site) specifically established for Project.
   a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
2. Submit electronic submittals via email as PDF electronic files to amyszak@myszakpalmer.com and cjordan@myszakpalmer.com
   a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
3. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.
4. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.
5. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
   a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
   b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Substitution Submittals MUST INCLUDE THE FOLLOWING

C. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
   a. Manufacturer's catalog cuts.
   b. Manufacturer's product specifications.
   c. Standard color charts.
   d. Statement of compliance with specified referenced standards.
   e. Testing by recognized testing agency.
   f. Application of testing agency labels and seals.
   g. Notation of coordination requirements.
   h. Availability and delivery time information.
   i. COPY OF MANUFACTURER'S WARRANTY
   j. a. confirming that ALL reused materials (nailers, insulation, metal) will be
   k. covered.
   l. b. Signed by a company officer.
   m. j.Material samples for those systems not already approved by the Architect.
4. For equipment, include the following in addition to the above, as applicable:

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

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:
   a. PDF electronic file.
   b. Three paper copies of Product Data unless otherwise indicated. Architect will return two copies.

D. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.
   1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
      a. Identification of products.
      b. Schedules.
      c. Compliance with specified standards.
      d. Notation of coordination requirements.
      e. Notation of dimensions established by field measurement.
      f. Relationship and attachment to adjoining construction clearly indicated.
      g. Seal and signature of professional engineer if specified.
   2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
   3. Submit Shop Drawings in the following format:
      a. PDF electronic file.
      b. Two opaque (bond) copies of each submittal. Architect will return one copy(ies).

E. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
   1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
   2. Identification: Attach label on unexposed side of Samples that includes the following:
      a. Generic description of Sample.
      b. Product name and name of manufacturer.
      c. Sample source.
      d. Number and title of applicable Specification Section.
   3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
   4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

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

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
   a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.
      1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

F. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
   1. Submit product schedule in the following format:
      a. PDF electronic file.
      b. Three paper copies of product schedule or list unless otherwise indicated. Architect will return two copies.

G. Coordination Drawings Submittals: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

H. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

I. Application for Payment and Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."

J. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."

K. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."

L. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

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

N. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

O. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

P. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

Q. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

R. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

S. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

T. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

U. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.

V. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."

W. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

X. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests

performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

Y. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

Z. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
   1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
   1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

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

B. Project Closeout and Maintenance Material Submittals: See requirements in Division 01 Section "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

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

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

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Testing and inspecting 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.

B. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements, comply with the most stringent requirement. Refer uncertainties to Architect for a decision.

C. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum. The actual installation may exceed the minimum within reasonable limits. Indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision.

D. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.

E. 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, and telephone number 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 inspecting.
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.

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

G. 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.

H. Testing Agency Qualifications: An independent agency with the experience and capability to conduct testing and inspecting indicated; and where required by authorities having jurisdiction, that is acceptable to authorities.

I. 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.

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

1. Notify Architect and Contractor of irregularities or deficiencies in the Work observed during performance of its services.
2. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
3. Do not perform any duties of Contractor.

K. Associated Services: Cooperate with testing agencies and provide reasonable auxiliary services as requested. 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 inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Security and protection for samples and for testing and inspecting equipment.

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

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

M. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction.

N. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

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

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

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

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

Abbreviations and Acronyms: 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. Names are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association, Inc. (The)
AAADM	American Association of Automatic Door Manufacturers
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ABAA	Air Barrier Association of America
ABMA	American Bearing Manufacturers Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies, Inc. (The)
AF&PA	American Forest & Paper Association
AGA	American Gas Association
AHAM	Association of Home Appliance Manufacturers
AHRI	Air-Conditioning, Heating, and Refrigeration Institute, The
AI	Asphalt Institute
AIA	American Institute of Architects (The)

AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALSC	American Lumber Standard Committee, Incorporated
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
AOSA	Association of Official Seed Analysts, Inc.
APA	Architectural Precast Association
APA	APA - The Engineered Wood Association
API	American Petroleum Institute
ARI	Air-Conditioning & Refrigeration Institute
ARMA	Asphalt Roofing Manufacturers Association
ASCE	American Society of Civil Engineers
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	ASME International (American Society of Mechanical Engineers International)
ASSE	American Society of Sanitary Engineering
ASTM	ASTM International (American Society for Testing and Materials International)
AWCI	Association of the Wall and Ceiling Industry
AWCMA	American Window Covering Manufacturers Association (Now WCMA)
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association (Formerly: American Wood Preservers' Association)
AWS	American Welding Society

AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association (The)
BICSI	BICSI, Inc.
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International)
BISSC	Baking Industry Sanitation Standards Committee
CCC	Carpet Cushion Council
CDA	Copper Development Association
CEA	Canadian Electricity Association
CEA	Consumer Electronics Association
CFFA	Chemical Fabrics & Film Association, Inc.
CGA	Compressed Gas Association
CIMA	Cellulose Insulation Manufacturers Association
CISCA	Ceilings & Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CPA	Composite Panel Association
CPPA	Corrugated Polyethylene Pipe Association
CRI	Carpet and Rug Institute (The)
CRRC	Cool Roof Rating Council
CRSI	Concrete Reinforcing Steel Institute
CSA	Canadian Standards Association
CSA	CSA International (Formerly: IAS - International Approval Services)

CSI	Cast Stone Institute
CSI	Construction Specifications Institute (The)
CSSB	Cedar Shake & Shingle Bureau
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)
DHI	Door and Hardware Institute
EIA	Electronic Industries Alliance
EIMA	EIFS Industry Members Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ESD	ESD Association (Electrostatic Discharge Association)
ETL SEMCO	Intertek ETL SEMCO (Formerly: ITS - Intertek Testing Service NA)
FM Approvals	FM Approvals LLC
FM Global	FM Global (Formerly: FMG - FM Global)
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.
FSA	Fluid Sealing Association
FSC	Forest Stewardship Council
GA	Gypsum Association
GANA	Glass Association of North America
GRI	(Part of GSI)
GS	Green Seal
GSI	Geosynthetic Institute
HI	Hydronics Institute
HI/GAMA	Hydronics Institute/Gas Appliance Manufacturers Association Division of Air-Conditioning, Heating, and Refrigeration Institute (AHRI)

HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)
HPVA	Hardwood Plywood & Veneer Association
IAPSC	International Association of Professional Security Consultants
ICBO	International Conference of Building Officials
ICEA	Insulated Cable Engineers Association, Inc.
ICPA	International Cast Polymer Association
ICRI	International Concrete Repair Institute, Inc.
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)
IESNA	Illuminating Engineering Society of North America
IEST	Institute of Environmental Sciences and Technology
IGMA	Insulating Glass Manufacturers Alliance
ILI	Indiana Limestone Institute of America, Inc.
ISA	Instrumentation, Systems, and Automation Society, The
ISO	International Organization for Standardization Available from ANSI
ISSFA	International Solid Surface Fabricators Association
ITS	Intertek Testing Service NA (Now ETL SEMCO)
ITU	International Telecommunication Union
KCMA	Kitchen Cabinet Manufacturers Association
LGSEA	Light Gauge Steel Engineers Association
LPI	Lightning Protection Institute
MBMA	Metal Building Manufacturers Association
MCA	Metal Construction Association

MFMA	Maple Flooring Manufacturers Association, Inc.
MFMA	Metal Framing Manufacturers Association, Inc.
MH	Material Handling (Now MHIA)
MHIA	Material Handling Industry of America
MIA	Marble Institute of America
MPI	Master Painters Institute
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
NAAMM	National Association of Architectural Metal Manufacturers
NACE	NACE International (National Association of Corrosion Engineers International)
NADCA	National Air Duct Cleaners Association
NAGWS	National Association for Girls and Women in Sport
NAIMA	North American Insulation Manufacturers Association
NBGQA	National Building Granite Quarries Association, Inc.
NCMA	National Concrete Masonry Association
NCTA	National Cable & Telecommunications Association
NEBB	National Environmental Balancing Bureau
NECA	National Electrical Contractors Association
NeLMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NETA	InterNational Electrical Testing Association
NFPA	NFPA (National Fire Protection Association)
NFRC	National Fenestration Rating Council
NGA	National Glass Association

NHLA	National Hardwood Lumber Association
NLGA	National Lumber Grades Authority
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association)
NOMMA	National Ornamental & Miscellaneous Metals Association
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	NSF International (National Sanitation Foundation International)
NSSGA	National Stone, Sand & Gravel Association
NTMA	National Terrazzo & Mosaic Association, Inc. (The)
PCI	Precast/Prestressed Concrete Institute
PDI	Plumbing & Drainage Institute
PGI	PVC Geomembrane Institute
PTI	Post-Tensioning Institute
RCSC	Research Council on Structural Connections
RFCI	Resilient Floor Covering Institute
RIS	Redwood Inspection Service
SAE	SAE International
SCAQMD	South Coast Air Quality Management District
SCTE	Society of Cable Telecommunications Engineers
SDI	Steel Deck Institute
SDI	Steel Door Institute
SEFA	Scientific Equipment and Furniture Association
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)
SIA	Security Industry Association

SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SMPTE	Society of Motion Picture and Television Engineers
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division)
SPIB	Southern Pine Inspection Bureau (The)
SPRI	Single Ply Roofing Industry
SSINA	Specialty Steel Industry of North America
SSPC	SSPC: The Society for Protective Coatings
STI	Steel Tank Institute
SWI	Steel Window Institute
TCNA	Tile Council of North America, Inc.
TEMA	Tubular Exchanger Manufacturers Association
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
TMS	The Masonry Society
TPI	Truss Plate Institute, Inc.
TPI	Turfgrass Producers International
TRI	Tile Roofing Institute
UL	Underwriters Laboratories Inc.
UNI	Uni-Bell PVC Pipe Association
USGBC	U.S. Green Building Council
USITT	United States Institute for Theatre Technology, Inc.
WASTEC	Waste Equipment Technology Association

WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association)
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California)
WIC	Woodwork Institute of California (Now WI)
WMMPA	Wood Moulding & Millwork Producers Association
WSRCA	Western States Roofing Contractors Association
WWPA	Western Wood Products Association

B. 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. Names, are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

DIN	Deutsches Institut fur Normung e.V.
IAPMO	International Association of Plumbing and Mechanical Officials
ICC	International Code Council
ICC-ES	ICC Evaluation Service, Inc.

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IAPMO	International Association of Plumbing and Mechanical Officials
ICC	International Code Council
ICC-ES	ICC Evaluation Service, Inc.

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 SECTION REQUIREMENTS

A. Use Charges: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated.

B. Provide connections and extensions of services as required for construction operations.

C. Erosion- and Sedimentation-Control Plan: Comply with plan showing compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

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

E. Accessible Temporary Egress: Comply with applicable provisions in ICC A117.1.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts and top and bottom rails.

2.2 TEMPORARY FACILITIES

A. Provide field offices, storage and fabrication sheds, and other support facilities as necessary for construction operations. Store combustible materials apart from building.

2.3 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 testing agency acceptable to authorities having jurisdiction, and marked for intended use.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction.

PART 3 - EXECUTION

3.1 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.

C. Heating and Cooling: Provide temporary heating and cooling required 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.

D. Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

3.2 SUPPORT FACILITIES INSTALLATION

A. Install project identification and other signs in locations approved by Owner to inform the public and persons seeking entrance to Project.

B. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

C. Temporary Elevator Use: Use of elevators is not permitted.

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. 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.

B. Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.

C. 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 environmentally safe materials.

D. Furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

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

F. 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.

G. Install and maintain temporary fire-protection facilities. Comply with NFPA 241.

3.4 MOISTURE AND MOLD CONTROL

A. Before installation of weather barriers, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.

1. Protect stored and installed material from flowing or standing water.
2. Remove standing water from decks.
3. Keep deck openings covered or dammed.

B. After installation of weather barriers but before full enclosure and conditioning of building, protect as follows:

1. Do not load or install drywall or porous materials into partially enclosed building.
2. Discard water-damaged material.
3. Do not install material that is wet.
4. Discard, replace, or clean stored or installed material that begins to grow mold.
5. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

3.5 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. 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.

C. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period.

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

B. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced.

1. Show compliance with requirements for comparable product requests.
2. Architect will review the proposed product and notify Contractor of its acceptance or rejection.

C. Basis-of-Design Product Specification Submittal: Show compliance with requirements.

D. Compatibility of Options: If Contractor is given option of selecting between two or more products, select product compatible with products previously selected.

E. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Deliver products to Project site in manufacturer's original sealed container or packaging, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
3. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
4. Store materials in a manner that will not endanger Project structure.
5. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.

F. 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.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. Provide products that comply with the Contract Documents, are undamaged, and, unless otherwise indicated, are new at the time of installation.

1. Provide products complete with accessories, trim, finish, and other devices and components needed for a complete installation and the intended use and effect.
2. Where products are accompanied by the term "as selected," Architect will make selection.
3. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Where the following headings are used to list products or manufacturers, the Contractor's options for product selection are as follows:

1. Products:

a. Where requirements include "one of the following," provide one of the products listed that complies with requirements.
b. Where requirements do not include "one of the following," provide one of the products listed that complies with requirements or a comparable product.

2. Manufacturers:

a. Where requirements include "one of the following," provide a product that complies with requirements by one of the listed manufacturers.
b. Where requirements do not include "one of the following," provide a product that complies with requirements by one of the listed manufacturers or another manufacturer.

3. Basis-of-Design Product: Provide the product named, or indicated on the Drawings, or a comparable product by one of the listed manufacturers.

C. Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

D. Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Architect will consider Contractor's request for comparable product when the following conditions are satisfied:

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.
3. List of similar installations for completed projects, if requested.
4. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017000 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 EXECUTION REQUIREMENTS

A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

B. Cutting and Patching:

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that result in increased maintenance or decreased operational life or safety.
3. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities.

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

1.2 CLOSEOUT SUBMITTALS

A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

B. Certified List of Incomplete Items: Final submittal at Final Completion.

C. Operation and Maintenance Data: Submit one copy of manual.

D. PDF Electronic File: Assemble manual into a composite electronically indexed file. Submit on digital media.

E. Record Drawings: Submit two hard copy set(s) of marked-up record prints. Submit PDF digital data file for owner/architect’s records also.

F. Record Product Data: Submit one paper copy and annotated PDF electronic files and directories of each submittal for the owner and architect’s records.

1.3 SUBSTANTIAL COMPLETION PROCEDURES

A. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.

B. Submittals Prior to Substantial Completion: Before requesting Substantial Completion inspection, complete the following:

1. 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 sections, including project record documents, operation and maintenance manuals, property surveys, similar final record information, warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
3. Submit maintenance material submittals specified in other sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect.
4. Submit test/adjust/balance records.
5. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Before requesting Substantial Completion inspection, complete the following:

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Advise Owner of changeover in heat and other utilities.
6. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
7. Remove temporary facilities and controls.
8. Complete final cleaning requirements, including touchup painting.
9. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will proceed with inspection or advise Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will advise Contractor of items that must be completed or corrected before certificate will be issued.

1.4 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting inspection for determining final completion, complete the following:

1. Submit a final Application for Payment.

2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

B. Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare final Certificate for Payment after inspection or will advise Contractor of items that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

PART 2 - PRODUCTS

2.1 MATERIALS

A. 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.

B. 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.

2.2 OPERATION AND MAINTENANCE DOCUMENTATION

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.

B. Organization: Unless otherwise indicated, organize manual into separate sections for each system and subsystem, and separate sections for each piece of equipment not part of a system.

C. Organize data into three-ring binders with identification on front and spine of each binder, and envelopes for folded drawings. Include the following:

1. Manufacturer's operation and maintenance documentation.
2. Maintenance and service schedules.

3. Maintenance service contracts. Include name and telephone number of service agent.
4. Emergency instructions.
5. Spare parts list and local sources of maintenance materials.
6. Wiring diagrams.
7. Copies of warranties. Include procedures to follow and required notifications for warranty claims

2.3 RECORD DRAWINGS, AS-BUILT DRAWINGS

A. Record Prints: Maintain a set of prints of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued. Mark to show actual installation where installation varies from that shown originally. Accurately record information in an acceptable drawing technique.

1. Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings.

1. Format: Same digital data software program, version, and operating system as the original Contract Drawings and Annotated PDF electronic file.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

B. 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.

1. Verify compatibility with and suitability of substrates.
2. Examine roughing-in for mechanical and electrical systems.
3. Examine walls, floors, and roofs for suitable conditions.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Take field measurements as required to fit the Work properly. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication.

E. Verify space requirements and dimensions of items shown diagrammatically on Drawings.

3.2 CONSTRUCTION LAYOUT AND FIELD ENGINEERING

A. Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks.

B. Engage a land surveyor to lay out the Work using accepted surveying practices.

C. Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project.

1. At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.3 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
3. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations.

C. 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.

D. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed.

E. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place. 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 Architect.

F. 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.

G. Use products, cleaners, and installation materials that are not considered hazardous.

3.4 CUTTING AND PATCHING

A. Provide temporary support of work to be cut.

B. 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.

C. Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

D. Cutting: Cut in-place construction using methods least likely to damage elements retained or adjoining construction.

1. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

E. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction in a manner that will minimize evidence of patching and refinishing.
2. Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance.
3. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

3.5 CLEANING

A. Clean Project site and work areas daily, including common areas. Dispose of materials lawfully.

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.
3. Remove debris from concealed spaces before enclosing the space.

B. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion:

1. Clean Project site, yard, and grounds, in areas disturbed by construction activities. Sweep paved areas; remove stains, spills, and foreign deposits. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
2. Sweep paved areas broom clean. Remove spills, stains, and other foreign deposits.

3. Remove labels that are not permanent.
4. Clean transparent materials, including mirrors. Remove excess glazing compounds.
5. Clean exposed finishes to a dust-free condition, free of stains, films, and foreign substances. Sweep concrete floors broom clean.
6. Vacuum carpeted surfaces and wax resilient flooring.
7. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and foreign substances. Clean plumbing fixtures. Clean light fixtures, lamps, globes, and reflectors.
8. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

3.6 OPERATION AND MAINTENANCE MANUAL PREPARATION

A. 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.

B. 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 unavailable and where the information is necessary for proper operation and maintenance of equipment or systems.

C. 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.

3.7 DEMONSTRATION AND TRAINING

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system. Include a detailed review of the following:

1. Include instruction for basis of system design and operational requirements, review of documentation, emergency procedures, operations, adjustments, troubleshooting, maintenance, and repairs.

END OF SECTION 017000

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 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. Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.2 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. Architect 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 Architect.
      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. Architect will return two copies.

C. Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
   1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 5 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

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.

B. 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.

C. 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 Construction Manager.
   7. Name and contact information for Architect.
   8. Name and contact information for Commissioning Authority.
   9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
   10. Cross-reference to related systems in other operation and maintenance manuals.

D. 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.

E. 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.

F. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
   1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
   2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks

reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

G. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
   1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
      a. 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. 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.

2.2 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.

2.3 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 is 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.

2.4 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.

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.

2.5 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.

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. 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.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. 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.

D. 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.

E. 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.

F. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.

B. Related Requirements:
   1. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   2. Divisions 02 through 33 Sections for specific requirements for project record documents of the Work in those Sections.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit one set(s) of marked-up record prints.
   2. Number of Copies: Submit copies of record Drawings as follows:
      a. Initial Submittal:
         1) Submit one paper-copy set(s) of marked-up record prints.
      b. Final Submittal:
         1) Submit PDF electronic files of scanned record prints and three set(s) of prints.
         2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy and annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one paper copy of each submittal.

PART 2 - PRODUCTS

2.1 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. Record data as soon as possible after obtaining it.
   c. Record and check the markup before enclosing concealed installations.
2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
4. 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 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.

2.2 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. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

2.3 RECORD PRODUCT DATA

A. 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.

B. Format: Submit record Product Data as scanned PDF electronic file(s) of marked-up paper copy of Product Data.

2.4 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 scanned PDF electronic file(s) of marked-up miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

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. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION

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. Demolition and removal of selected portions of building or structure.
   2. Demolition and removal of selected site elements.
   3. Salvage of existing items to be reused or recycled.

B. Related Requirements:
   1. Section 011000 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
   2. Section 017300 "Execution" for cutting and patching procedures.
   3. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items

of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.
1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's, building manager's, and other tenants' on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

E. Predemolition Photographs or Video: Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. Hazardous materials will be removed by Owner before start of the Work.
   2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
   1. Hazardous material remediation is specified elsewhere in the Contract Documents.
   2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
   3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.

F. Storage or sale of removed items or materials on-site is not permitted.

G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:
   1. TPO roofing.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
   1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
   2. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

F. Survey of Existing Conditions: Record existing conditions by use of measured drawings.
   1. Comply with requirements specified in Section 013233 "Photographic Documentation."
   2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
   3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
   1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
   1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
   2. Arrange to shut off indicated utilities with utility companies.
   3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
   4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
      a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
      b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
      c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
      d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
      e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
      f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
      g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
   1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
   2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
   3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
   4. Cover and protect furniture, furnishings, and equipment that have not been removed.
   5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
   1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
   2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
   3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
   5. Maintain adequate ventilation when using cutting torches.

6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:
1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 075419 “Polyvinyl Chloride Roofing.”
1. Remove existing roof membrane, flashings, copings, and roof accessories.

2. Remove existing roofing system down to substrate.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
   3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
   4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials and dispose of at designated spoil areas on Owner's property.

D. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. NOTE!! SEE STRUCTURAL DRAWINGS/SPECIFICATIONS FOR ADDITIONAL CAST-IN - PLACE CONCRETE INFORMATION. SPECIFICATIONS PROVIDED ON STRUCTURAL DRAWINGS SHALL OVERRIDE THIS SPECIFICATION SECTION. ANY QUESTIONS OR DEVIATIONS BETWEEN THIS SPECIFICATION SECTION AND STRUCTURAL DRAWINGS SHALL BE BROUGHT TO THE ATTENTION OF THE ARCHITECT PRIOR TO BIDDING FOR CLARIFICATION.

B. Submittals: concrete mix designs and submittals required by ACI 301.

C. Ready-Mixed Concrete Producer Qualifications: ASTM C 94/C 94M.

D. Comply with ACI 301, "Specification for Structural Concrete"; ACI 117, "Specifications for Tolerances for Concrete Construction and Materials"; and CRSI's "Manual of Standard Practice."

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Plain Steel Wire: ASTM A 82, as drawn.

C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

E. Portland Cement: ASTM C 150, Type I or II.

F. Fly Ash: ASTM C 618, Type C or F.

G. Aggregates: ASTM C 33, uniformly graded.

H. Synthetic Fiber: ASTM C 1116, Type III, polypropylene fibers, 1/2 to 1-1/2 inches (13 to 38 mm) long.

I. Air-Entraining Admixture: ASTM C 260.

J. Chemical Admixtures: ASTM C 494,. Do not use calcium chloride or admixtures containing calcium chloride.

K. Vapor Retarder: Clear 15 mil. thick polyethylene sheet.

L. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

M. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

N. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

O. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

P. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.2 MIXES

A. Comply with ACI 301 requirements for concrete mixtures.

B. Normal-Weight Concrete: Prepare design mixes, proportioned according to ACI 301, as follows:

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45 Insert ratio.
3. Slump Limit: 4 inches (100 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture] Insert dimension, plus or minus 1 inch (25 mm).
4. Air Content: Maintain within range permitted by ACI 301. Do not allow air content of floor slabs to receive troweled finishes to exceed 3 percent.

C. Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116.

1. When air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 CONCRETING

A. Construct formwork according to ACI 301 and maintain tolerances and surface irregularities within ACI 347R limits of Class A, 1/8 inch (3.2 mm) for concrete exposed to view and Class C, 1/2 inch (13 mm) for other concrete surfaces.

B. Place vapor retarder on prepared subgrade, with joints lapped 6 inches (150 mm) and sealed.

C. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

D. Install construction, isolation, and contraction joints where indicated. Install full-depth joint-filler strips at isolation joints.

E. Place concrete in a continuous operation and consolidate using mechanical vibrating equipment.

F. Protect concrete from physical damage, premature drying, and reduced strength due to hot or cold weather during mixing, placing, and curing.

G. Formed Surface Finish: Smooth-formed finish for concrete exposed to view, coated, or covered by waterproofing or other direct-applied material; rough-formed finish elsewhere.

H. Slab Finishes: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces. Provide the following finishes:

1. Scratch finish for surfaces to receive mortar setting beds.
2. Float finish for interior steps and ramps and surfaces to receive waterproofing, roofing, or other direct-applied material.
3. Troweled finish for floor surfaces and floors to receive floor coverings, paint, or other thin film-finish coatings.
4. Trowel and fine-broom finish for surfaces to receive thin-set tile.
5. Nonslip-broom finish to exterior concrete platforms, steps, and ramps.

I. Cure formed surfaces by moist curing for at least seven days.

J. Begin curing concrete slabs after finishing. Apply membrane-forming curing compound to concrete.

K. Owner will engage a testing agency to perform field tests and to submit test reports.

L. Protect concrete from damage. Repair surface defects in formed concrete and slabs.

END OF SECTION 033000

SECTION 040120 - MAINTENANCE OF UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes maintenance of unit masonry consisting of brick clay masonry restoration and cleaning as follows:

1. Repairing unit masonry, including replacing units.
2. Repointing joints.
3. Preliminary cleaning, including removing plant growth.
4. Cleaning exposed unit masonry surfaces.

1.2 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm

B. Medium-Pressure Spray: 400 to 800 psi; 4 to 6 gpm

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on masonry units as follows.

1. Existing Brick: Test each type of existing masonry unit indicated for replacement, according to testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, 5-hour boil absorption, saturation coefficient, and initial rate of absorption (suction). Carefully remove five existing units from locations designated by Architect. Take testing samples from these units.
2. Existing Mortar: Test according to ASTM C 295, modified as agreed by testing service and Architect for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength. Use X-ray diffraction, infrared spectroscopy, and differential thermal analysis as necessary to supplement microscopical methods. Carefully remove existing mortar from within joints at five locations designated by Architect.
3. Temporary Patch: As directed by Architect, provide temporary materials at locations from which existing samples were taken.
4. Replacement Brick: Test each proposed type of replacement masonry unit, according to sampling and testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, 5-hour boil absorption, saturation coefficient, and initial rate of absorption (suction).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:
   1. Provisions for expansion joints or other sealant joints.

PART 2 - PRODUCTS

2.1 MASONRY MATERIALS

A. Face Brick: Provide face brick, including specially molded, ground, cut, or sawed shapes where required to complete masonry restoration work.

   1. Provide units with physical properties, colors, color variation within units, surface texture, size, and shape to match existing brickwork.

      a. Physical Properties per ASTM C 67:

      b. For existing brickwork that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range and variation rather than brick that matches an individual color within that ; range.

B. Stone: Provide stone including specially molded, ground, cut, or sawed shapes where required to complete masonry restoration work.

   1. Provide units with physical properties, colors, color variation within units, surface texture, size, and shape to match existing stone work.

2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type II, white or gray or both where required for color matching of exposed mortar.

   1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Mortar Sand: ASTM C 144 unless otherwise indicated.

   1. Color: Provide natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
   2. For pointing mortar, provide sand with rounded edges.
   3. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.

D. Mortar Pigments: Natural and synthetic iron oxides, compounded for mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortars.

E. Water: Potable.

2.3 MANUFACTURED REPAIR MATERIALS

A. Masonry Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching masonry.

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. Cathedral Stone Products, Inc.; Jahn M100 Terra Cotta and Brick Repair Mortar.
   b. Conproco Corporation
   c. Edison Coatings, Inc.; Custom System 45.

2. Use formulation that is vapor- and water permeable (equal to or more than the masonry unit), exhibits low shrinkage, has lower modulus of elasticity than the masonry units being repaired, and develops high bond strength to all types of masonry.
3. Formulate patching compound used for patching [brick] [and] [terra cotta] in colors and textures to match each masonry unit being patched.

2.4 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Job-Mixed Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium polyphosphate, 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Job-Mixed Mold, Mildew, and Algae Remover: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium polyphosphate, 5 quarts (5 L) of 5 percent sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every 5 gal. (20 L) of solution required.

E. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood.

1. Products: Subject to compliance with requirements, provide the following
   a. PROSOCO; Enviro Klean 2010 All Surface Cleaner.

2.5 ACCESSORY MATERIALS

A. Setting Buttons: Resilient plastic buttons, nonstaining to masonry, sized to suit joint thicknesses and bed depths of masonry units without intruding into required depths of pointing materials.

2.6 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Do not use admixtures in mortar unless otherwise indicated.

C. Mortar Proportions: Mix mortar materials in the following proportions:

1. Pointing Mortar for Brick/Stone: 1 part portland cement, 2 parts lime, and 6 parts sand

a. Add mortar pigments to produce mortar colors required.

2.7 CHEMICAL CLEANING SOLUTIONS

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended by chemical-cleaner manufacturer.

B. Acidic Cleaner Solution for Brick: Dilute with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended by chemical-cleaner manufacturer.

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from masonry restoration work.

B. Comply with chemical-cleaner manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical-cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist chemical cleaners used unless chemical cleaners being used will not damage adjacent surfaces. Use materials that contain only waterproof, UV-resistant adhesives. Apply masking agents to comply with manufacturer's written instructions. When no longer needed, promptly remove masking to prevent adhesive staining.
2. Keep wall wet below area being cleaned to prevent streaking from runoff.

3.2 BRICK REMOVAL AND REPLACEMENT

A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated or are to be reuse. Carefully demolish or remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Support and protect remaining masonry that surrounds removal area. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

C. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.

D. Remove in an undamaged condition as many whole bricks as possible.

1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.

E. Clean bricks surrounding removal areas by removing mortar, dust, and loose particles in preparation for replacement.

F. Replace removed damaged brick with other removed brick in good quality, where possible, or with new brick matching existing brick, including size. Do not use broken units unless they can be cut to usable size.

G. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

1. Maintain joint width for replacement units to match existing joints.
2. Use setting buttons or shims to set units accurately spaced with uniform joints.

H. Lay replacement brick with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of

more than 30 g/30 sq. in. per min. Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.

1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
2. Rake out mortar used for laying brick before mortar sets and point new mortar joints in repaired area to comply with requirements for repointing existing masonry, and at same time as repointing of surrounding area.
3. When mortar is sufficiently hard to support units, remove shims and other devices interfering with pointing of joints.

3.3 MASONRY UNIT PATCHING

A. Patching Bricks:

1. Remove loose material from masonry surface. Carefully remove additional material so patch will not have feathered edges but will have square or slightly undercut edges on area to be patched and will be at least 1/4 inch thick, but not less than recommended by patching compound manufacturer.
2. Mask adjacent mortar joint or rake out for repointing if patch will extend to edge of masonry unit.
3. Mix patching compound in individual batches to match each unit being patched.
4. Rinse surface to be patched and leave damp, but without standing water.
5. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
6. Place patching compound in layers as recommended by patching compound manufacturer, but not less than 1/4 inch or more than 2 inches thick. Roughen surface of each layer to provide a key for next layer.
7. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the masonry unit. Shape and finish surface before or after curing, as determined by testing, to best match existing masonry unit.
8. Keep each layer damp for 72 hours or until patching compound has set.

3.4 CLEANING MASONRY, GENERAL

A. Proceed with cleaning in an orderly manner; work from top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water will not wash over cleaned, dry surfaces.

B. Use only those cleaning methods indicated for each masonry material and location.

1. Do not use wire brushes or brushes that are not resistant to chemical cleaner being used. Do not use plastic-bristle brushes if natural-fiber brushes will resist chemical cleaner being used.
2. Use spray equipment that provides controlled application at volume and pressure indicated, measured at spray tip. Adjust pressure and volume to ensure that cleaning methods do not damage masonry.

    a. Equip units with pressure gages.

3. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with cone-shaped spray tip.
4. For water-spray application, use fan-shaped spray tip that disperses water at an angle of 25 to 50 degrees.
5. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F at flow rates indicated.

C. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces.

D. Water-Spray Application Method: Unless otherwise indicated, hold spray nozzle at least 6 inches from surface of masonry and apply water in horizontal back and forth sweeping motion, overlapping previous strokes to produce uniform coverage.

E. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces to comply with chemical-cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi . Do not allow chemicals to remain on surface for periods longer than those indicated or recommended by manufacturer.

F. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

3.5 PRELIMINARY CLEANING

A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing to dry as long as possible before removal. Remove loose soil and debris from open masonry joints to whatever depth they occur.

B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to cleaning methods being used. Extraneous substances include paint, calking, asphalt, and tar.

1. Carefully remove heavy accumulations of material from surface of masonry with a sharp chisel. Do not scratch or chip masonry surface.
2. Remove paint and calking with alkaline paint remover.

   a. Comply with requirements in "Paint Removal" Article.
   b. Repeat application up to two times if needed.

3. Remove asphalt and tar with solvent-type paint remover.

   a. Comply with requirements in "Paint Removal" Article.

b. Apply paint remover only to asphalt and tar by brush without prewetting.
c. Allow paint remover to remain on surface for 10 to 30 minutes.
d. Repeat application if needed.

C. Mold, Mildew, and Algae Removal:

1. Wet masonry with cold water applied by low-pressure spray.
2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
3. Scrub masonry with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that masonry surface remains wet.
4. Rinse with cold water applied by medium-pressure spray to remove mold, mildew, and algae remover and soil.
5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

D. Mild Acidic Chemical Cleaning:

1. Wet masonry with cold water applied by low-pressure spray.
2. Apply cleaner to masonry in two applications by brush or low-pressure spray. Let cleaner remain on surface for period indicated below:

   a. As recommended by chemical-cleaner manufacturer.
   b. As established by mockup.

3. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.
4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once.

3.6 REPOINTING MASONRY

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints where mortar is missing or where they contain holes.
3. Cracked joints where cracks can be penetrated at least 1/4 inch by a knife blade 0.027 inch thick.
4. Cracked joints where cracks are 1/16 inch or more in width and of any depth.
5. Joints where they sound hollow when tapped by metal object.
6. Joints where they are worn back 1/4 inch or more from surface.
7. Joints where they are deteriorated to point that mortar can be easily removed by hand, without tools.
8. Joints where they have been filled with substances other than mortar.
9. Joints indicated as sealant-filled joints.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of joint width plus 1/8 inch, but not less than 1/2 inch or not less than that required to expose sound, unweathered mortar.
2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of masonry units or widen joints. Replace or patch damaged masonry units as directed by Architect.

    a. Cut out mortar by hand with chisel and resilient mallet. Do not use power-operated grinders.
    b. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Remove remaining mortar by hand with chisel and resilient mallet.

D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
3. After low areas have been filled to same depth as remaining joints, point all joints by placing mortar in layers not greater than 3/8 inch. Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours including weekends and holidays.

    a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.

6. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

F. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.7 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, spray applied at low pressure.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040120

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Samples for face brick and colored mortar.
2. Material Certificates: For each type of product indicated. Include statements of material properties indicating compliance with requirements.

B. Comply with ACI 530.1/ASCE 6/TMS 602.

C. Sample Panels: Construct a sample wall panel approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high to demonstrate aesthetic effects and set quality standards for materials and execution.

PART 2 - PRODUCTS

2.1 MASONRY UNITS

A. Face Brick: ASTM C 216, Grade SW, Modular Type.

1. Products:

a. To match existing building. Basis of Design: Endicott Clay Products Co., Medium Ironspot #46, Modular Vertical Score

2. Solid brick with exposed surfaces finished for ends of sills and caps.
3. Special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Concrete Masonry Units: ASTM C 90; Weight Classification, Normal Weight.
1. Square-edged units for outside corners, unless otherwise indicated.
2. Structural drawings and specifications will supersede this specification.

2.2 MORTAR AND GROUT

A. Mortar: ASTM C 270, proportion specification.

1. Masonry Cement: Do not use masonry cement or plastic cement.
2. Do not use calcium chloride in mortar.
3. For masonry below grade or in contact with earth, use Type S.
4. For reinforced masonry, use Type S.

5. 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.
6. Colored Mortar: For face brick burnished & split face block, use colored cement or cement-lime mix of color selected by architect from samples provided.
7. Water-Repellent Additive: For mortar used with concrete masonry units made with integral water repellent, use product recommended by manufacturer of units.

B. Grout: ASTM C 476 with a slump of 8 to 11 inches (200 to 280 mm).

2.3 REINFORCEMENT, TIES, AND ANCHORS

A. Steel Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 400).

B. Joint Reinforcement: ASTM A 951.

1. Coating: Hot-dip galvanized at both interior and exterior walls.
2. Wire Diameter for Side Rods: W1.7 or 0.148 inch (3.8 mm).
3. Wire Diameter for Cross Rods: W1.7 or 0.148 inch (3.8 mm).
4. For single-wythe masonry, provide either ladder design or truss design.

C. Veneer Anchors: Hot-dip galvanized steel, two-piece adjustable masonry veneer anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to studs, and acceptable to authorities having jurisdiction.

1. Available Products:

a. Submit for architect approval.

2.4 EMBEDDED FLASHING MATERIALS

A. Sheet Metal Flashing: aluminum for all exposed flashing.

B. Vinyl Flashing: For all concealed locations.

2.5 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded strips complying with ASTM D 1056, Grade 2A1.

B. Preformed Control-Joint Gaskets: Designed to fit standard sash block and to maintain lateral stability in masonry wall; made from styrene-butadiene rubber or PVC.

C. Weep Holes: Round polyethylene tubing, 3/8-inch (9.5-mm) OD.

D. Proprietary Acidic Masonry Cleaner: Product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units.

1. Available Products:

   a. Prosoco, Inc.; ‘Sure Klean 600’

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cut masonry units with saw. Install with cut surfaces and, where possible, cut edges concealed.

B. Mix units for exposed unit masonry from several pallets or cubes as they are placed to produce uniform blend of colors and textures.

C. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

D. Stopping and Resuming Work: Rack back units; do not tooth.

E. Fill cores in hollow concrete masonry units with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

F. Tool exposed joints slightly concave when thumbprint hard, unless otherwise indicated.

G. Keep cavities clean of mortar droppings and other materials during construction.

3.2 LINTELS

A. Install steel lintels where required, paint all exposed surfaces.

B. Minimum bearing of 8 inches (200 mm) at each jamb, unless otherwise indicated.

3.3 FLASHING AND WEEP HOLES

A. Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to the downward flow of water in the wall, and where indicated.

   1. Extend flashing 4 inches (100 mm) into masonry at each end and turn up 2 inches (50 mm) to form a pan.

B. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing before covering with mortar.

   1. Extend flashing 4 inches (100 mm) into masonry at each end and turn up 2 inches (50 mm) to form a pan.

3.4 CLEANING

A. Clean masonry as work progresses. Remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly cured, clean exposed masonry.

1. Wet wall surfaces with water before applying acidic cleaner, then remove cleaner promptly by rinsing thoroughly with clear water.
2. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 042000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data, Statement of Recycled Content, Shop Drawings, Welding Procedure Specifications (WPSs), and mill test reports.

B. NOTE!! SEE STRUCTURAL DRAWINGS/SPECIFICATIONS FOR ADDITIONAL STRUCTURAL STEEL INFORMATION. SPECIFICATIONS PROVIDED ON STRUCTURAL DRAWINGS SHALL OVERRIDE THIS SPECIFICATION SECTION. ANY QUESTIONS OR DEVIATIONS BETWEEN THIS SPECIFICATION SECTION AND STRUCTURAL DRAWINGS SHALL BE BROUGHT TO THE ATTENTION OF THE ARCHITECT PRIOR TO BIDDING FOR CLARIFICATION.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of connections required by the Contract Documents to be selected or completed by structural-steel fabricator.

1. Use LRFD; data are given at factored-load level.

B. Comply with applicable provisions of the following:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

2.2 STRUCTURAL STEEL

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. W-Shapes: ASTM A 992/A 992M.

C. Channels, Angles, M , S-Shapes: ASTM A 36/A 36M.

D. Plate and Bar: ASTM A 36/A 36M.

E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

F. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.

2.3 ACCESSORIES

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.

B. Anchor Rods: ASTM F 1554, Grade 36.

1. Configuration: Straight, or hooked as indicated on Structural Drawings.
2. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.

C. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

D. Grout: ASTM C 1107, nonmetallic, shrinkage resistant, factory packaged.

2.4 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.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

C. Shop Priming: Prepare surfaces according to SSPC-SP 2, "Hand Tool Cleaning"; or SSPC-SP 3, "Power Tool Cleaning." Shop prime steel to a dry film thickness of at least 1.5 mils (0.038 mm). Do not prime surfaces to be embedded in concrete or mortar or to be field welded.

PART 3 - EXECUTION

3.1 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 base plate.

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.

C. Align and adjust various members forming 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.

D. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

E. 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.

1. Joint Type: Snug tightened.

F. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

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 deck.

B. Related Requirements:
   1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
   2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
   3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
   4. Section 099113 "Exterior Painting" for repair painting of primed deck and finish painting of deck.
   5. Section 099123 "Interior Painting" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:
   1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
   1. Power-actuated mechanical fasteners.

2. Acoustical roof deck.

D. Evaluation Reports: For steel deck.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

C. Electrical Raceway Units: Provide UL-labeled cellular floor-deck units complying with UL 209 and listed in UL's "Electrical Construction Equipment Directory" for use with standard header ducts and outlets for electrical distribution systems.

D. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
   1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ASC Profiles, Inc.; a Blue Scope Steel company.
   2. Canam United States; Canam Group Inc.
   3. CMC Joist & Deck.
   4. Consolidated Systems, Inc.; Metal Dek Group.
   5. Cordeck.
   6. DACS, Inc.
   7. Epic Metals Corporation.
   8. Marlyn Steel Decks, Inc.
   9. New Millennium Building Systems, LLC.
   10. Nucor Corp.; Vulcraft Group.
   11. Roof Deck, Inc.
   12. Valley Joist; Subsidiary of EBSCO Industries, Inc.
   13. Verco Manufacturing Co.
   14. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
   15.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
   1. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS),; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
      a. Color: White.
   2. Aluminum-Zinc-Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Structural Steel (SS), Grade 33 minimum, AZ50 aluminum-zinc-alloy coating.
   3. Deck Profile: As indicated.
   4. Profile Depth: As indicated.
   5. Span Condition: As indicated.
   6. Side Laps: Overlapped or interlocking seam at Contractor's option.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
   1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
   1. Weld Diameter: As indicated
   2. Weld Spacing: As indicated

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps as indicated
   1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
   2. Mechanically clinch or button punch.
   3. Fasten with a minimum of 1-1/2-inch-long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
   1. End Joints: Lapped 2 inches minimum.
   2. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

D. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
   1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
   2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Load-bearing wall framing.
   2. Exterior non-load-bearing wall framing.
   3. Floor joist framing.
   4. Roof rafter framing.
   5. Ceiling joist framing.
   6. Soffit framing.

B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for masonry shelf angles and connections.
   2. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed steel framing product and accessory.

B. Shop Drawings:
   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel framing.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.
1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

D. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AllSteel & Gypsum Products, Inc.
2. California Expanded Metal Products Company.
3. ClarkWestern Building Systems, Inc.
4. Consolidated Fabricators Corp.; Building Products Division.
5. Craco Mfg., Inc.
6. Custom Stud Inc.
7. Design Shapes in Steel.
8. Dietrich Metal Framing; a Worthington Industries Company.
9. Formetal Co. Inc. (The).
10. MarinoWARE.
11. Nuconsteel; a Nucor Company.
12. Olmar Supply, Inc.
13. Quail Run Building Materials, Inc.
14. SCAFCO Corporation.
15. Southeastern Stud & Components, Inc.
16. State Building Products, Inc.
17. Steel Construction Systems.
18. Steel Network, Inc. (The).
19. Steel Structural Systems.
20. Steeler, Inc.
21. Super Stud Building Products, Inc.
22. Telling Industries, LLC.
23. United Metal Products, Inc.
24. United Steel Manufacturing.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
   1. Design Loads: As indicated.
   2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. Exterior Load-Bearing Wall Framing: As recommended by Structural Engineer.
      b. Interior Load-Bearing Wall Framing: As recommended by Structural Engineer.
      c. Exterior Non-Load-Bearing Framing: As recommended by Structural Engineer.
      d. Roof Rafter Framing: As recommended by Structural Engineer.
      e. Ceiling Joist Framing: As recommended by Structural Engineer.
   3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).

4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
   a. Upward and downward movement tolerances shall be set by project Structural Engineer.
5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Design Standards:
   1. Floor and Roof Systems: AISI S210.
   2. Wall Studs: AISI S211.
   3. Headers: AISI S212.
   4. Lateral Design: AISI S213.

D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   1. Grade: As required by structural performance.
   2. Coating: Per Structural Engineer.

B. Steel Sheet for Vertical Deflection Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: As required by structural performance.
   2. Coating: Per Structural Engineer.

2.4 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm) 20ga..
   2. Flange Width: 2 inches (51 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm) 20ga.
   2. Flange Width: 1-1/4 inches (32 mm).

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
2. Flange Width: 2 inches (51 mm).

D. Steel Single- or Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:
1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
2. Top Flange Width: 2 inches (51 mm).

2.5 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.8 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
   4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 LOAD-BEARING WALL INSTALLATION

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
   1. Anchor Spacing: 24 inches (610 mm) or As shown on Shop Drawings.

B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch (3 mm) between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
   1. Stud Spacing: 16 inches (406 mm) or as indicated by Structural Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
   1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
   2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
   1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically as indicated on Shop Drawings. Fasten at each stud intersection.
   1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches (150 mm) deep.
   2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
   3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ladders, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

A. Structural Performance of Aluminum Ladders: Aluminum ladders shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Metal Fixed Wall ladders

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1.4 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

C. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.

1. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches (600 mm) o.c.

D. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.

1.5 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

C. Prime miscellaneous steel trim with zinc-rich primer.

1.6 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

1.7 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

B. Galvanize loose steel lintels located in exterior walls.

C. Prime loose steel lintels located in exterior walls with zinc-rich primer.

1.8 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

1.9 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.

1.10 NONFERROUS METALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

1.11 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls.

1. Provide stainless-steel fasteners for fastening aluminum.

B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

1.12 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.

C. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended.

D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.

E. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 24 inches o.c.

G. Fabricate loose lintels from steel angles and shapes. Size to provide bearing length at each side of openings not less than 8”.

1.13 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

PART 2 - EXECUTION

2.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

2.2 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

END OF SECTION 055000

SECTION 055100 - METAL STAIRS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data, Shop Drawings, and structural analysis data signed and sealed by a qualified professional engineer registered in the state where Project is located.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: One of the following:

1. Alfab, Inc.
2. American Stair, Inc.
3. Sharon Companies Ltd. (The).

2.2 PERFORMANCE REQUIREMENTS

A. Provide stairs capable of withstanding a uniform load of 100 lbf/sq. ft. (4.79 kN/sq. m) and a concentrated load of 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm). Uniform and concentrated loads need not be assumed to act concurrently.

B. Provide railings capable of withstanding a uniform load of 50 lbf/ft. (0.73 kN/m) and a concentrated load of 200 lbf (0.89 kN) applied to handrails and top rails of guards in any direction. Uniform and concentrated loads need not be assumed to act concurrently.

C. Provide railing infill capable of withstanding a concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m). Infill load and other railing loads need not be assumed to act concurrently.

2.3 METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.

C. Rolled Steel Floor Plate: ASTM A 786/A 786M.

D. Iron Castings: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M.

E. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170).

F. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205).

G. Expanded Metal, Carbon Steel: ASTM F 1267, Class 1 (uncoated).

H. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

2.4 MISCELLANEOUS MATERIALS

A. Concrete: Comply with Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

B. Welded Wire Fabric: ASTM A 185, 6 by 6 inches (152 by 152 mm) - W1.4 by W1.4.

2.5 FABRICATION

A. General: Shear and punch metals cleanly and accurately. Remove burrs and ease exposed edges. Form bent-metal corners to smallest radius possible without impairing work.

B. Welding: Use materials and methods that minimize distortion and develop strength of base metals. At exposed connections, finish welds and surfaces smooth.

C. Stair Framing: Fabricate stringers of steel plates or channels. Construct platforms of steel plate or channel headers and miscellaneous framing members.

D. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch (1.7 mm) thick.

E. Abrasive-Coating-Finished, Formed-Metal Stairs: Form risers, treads, and platforms from steel sheet of thickness needed to comply with performance requirements, but not less than 0.097 inch (2.5 mm) thick. Finish tread and platform surfaces with manufacturer's standard, epoxy-bonded abrasive finish.

F. Steel Tube Railings: Fabricate railings to comply with requirements indicated, but not less than that needed to withstand indicated loads.

1. Configuration: 1-1/2-inch- (38-mm-) square top and bottom rails, 1-1/2-inch- (38-mm-) square posts, and 1/2-inch- (13-mm-) square pickets spaced less than 4 inches (100 mm) clear.
2. Configuration: 1-1/2-inch- (38-mm-) square top and bottom rails and posts with infill panels made from expanded metal.
3. Configuration: 1-1/2-inch- (38-mm-) square top, bottom, and intermediate rails and posts. Space intermediate rails less than 12 inches (305 mm) clear.

4. Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose.
5. Form changes in direction of railings by bending or by inserting prefabricated fittings.
6. Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.
7. Connect posts to stair framing by direct welding.

2.6 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Finish metal stairs after assembly.

B. Hot-dip galvanize steel stairs at exterior locations.

C. Prepare uncoated ferrous metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning," and paint with a fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete." Install abrasive nosings with anchors fully embedded in concrete.

D. Attach handrails to wall with wall brackets. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.

END OF SECTION 055100

SECTION 055200 - METAL RAILINGS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data Shop Drawings, structural analysis data signed and sealed by a qualified professional engineer registered in the state where Project is located, and manufacturer's color charts showing the full range of colors available for factory-applied finishes.

PART 2 - PRODUCTS

2.1 RAILING SYSTEMS

A. Manufacturers: One of the following:

1. Steel Pipe and Tube Railings:

   a. Pisor Industries, Inc.
   b. Wagner, R & B, Inc.; a division of the Wagner Companies.

B. Provide railings capable of withstanding a uniform load of 50 lbf/ft. (0.73 kN/m) and a concentrated load of 200 lbf (0.89 kN) applied to handrails and top rails of guards in any direction. Uniform and concentrated loads need not be assumed to act concurrently.

C. Provide railing infill capable of withstanding a concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m). Infill load and other railing loads need not be assumed to act concurrently.

2.2 METALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.

C. Steel Pipe: ASTM A 53, Schedule 40.

D. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

E. Iron Castings: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

F. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.3 OTHER MATERIALS

A. Nonshrink, Nonmetallic Grout: ASTM C 1107; recommended by manufacturer for exterior applications.

2.4 FABRICATION

A. Assemble railing systems in shop to the greatest extent possible. Use connections that maintain structural value of joined pieces.

B. Form changes in direction of railing members by bending.

C. Fabricate railing systems and handrails for connecting members by welding.

D. Provide manufacturer's standard wall brackets, flanges, miscellaneous fittings, and anchors to connect handrail and railing members to other construction.

E. Provide wall returns at ends of wall-mounted handrails.

2.5 FINISHES

A. Steel Railings: Cleaned and shop primed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fit exposed connections accurately together to form tight, hairline joints.

B. Set railings accurately in location, alignment, and elevation and free of rack.

C. Anchor posts in concrete by forming or core-drilling holes 5 inches (125 mm) deep and 3/4 inch (20 mm) greater than OD of post. Fill annular space between post and concrete with nonshrink, nonmetallic grout.

D. Attach handrails to wall with wall brackets.

END OF SECTION 055200

SECTION 057300 – ALUMINUM RAILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Ornamental stainless steel cable railing system. (Rainier)

B. Ornamental stainless steel railing system with glass infill. (Glacier)

C. Ornamental stainless steel railing system with horizontal bars. (Olympus)

1.2 RELATED SECTIONS

A. Section 06 10 00 - Rough Carpentry.

B. Section 06 46 13 - Wood Door and Window Casings.

C. Section 08 83 13 - Mirrored Glass Glazing.

1.3 REFERENCES

A. ASTM International (ASTM):
1. ASTM A 554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
2. ASTM A 492 - Standard Specification for Stainless Steel Rope Wire.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: Manufacturer's specifications and technical data including the following:
1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.

C. Shop Drawings: Submit shop drawings for fabrication and installation. Include the following:
1. Plans, elevations, and detail sections.
2. Indicate materials, methods, finishes, and types of joinery, fasteners, anchorages, and accessory items.
3. Where materials or fabrications are indicated to comply with certain design loadings, include structural computations, material properties, and other information needed for structural analysis.

D. Samples: Prepare samples on metal of same alloy and thickness to be used for the Work.

E. Quality Control Submittals: Statement of manufacturer's qualifications.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.

B. Installer's Qualifications: Firm with demonstrated experience in installation of systems similar in complexity to those required for this Project.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations and industry standards.

B. Store materials in manufacturer's original sealed, labeled packaging until ready for installation and in accordance with manufacturer's instructions. Protect from damage.

1.7 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 recommended limits.

1.8 WARRANTY

A. Manufacturer's Warranty: Provide manufacturer's standard 3 year limited warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: AGS Stainless, Inc. - Cable Rail, which is located at: 7873 N. E. Day Rd.; Bainbridge Island, WA 98110; Toll Free Tel: 888-842-9492; Tel: 206-842-9492; Fax: 206-842-8179 ; Email: request info (info@agsstainless.com); Web: www.agsstainless.com

B. Substitutions: permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 SYSTEM DESCRIPTION - GENERAL

A. Custom, shop-fabricated stainless steel railing frame with mechanical fittings and attachment for field installation.
   1. Infill: Glass panels.
   2. Infill: Horizontal cabling.
   3. Infill: Horizontal bar.

B. Shop fabricate such that no jobsite welding, grinding or cutting is required.

2.3 STAINLESS STEEL RAILING SYSTEMS

A. Stainless Steel Railing System: Clearview Railing System as manufactured by AGS Stainless, Inc.
   1. Type: Rainier - Cable railing.
   2. Type: Glacier - Glass railing.
   3. Type: Olympus - Horizontal bar railing.
   4. Fabrication: Factory welded components. Verify dimensions on site prior to shop fabrication.
      a. Mill joints to a tight, hairline fit.

b. Miter corner joints.
5. Structural Requirements: Fabricate integral railings and component connections to meet or exceed the requirements as set forth in the current, adopted ICC International Building Code (IBC), International Residential Code (IRC), or governing local code as applicable.

B. Posts:
1. Post Material: ASTM A 554, Type A316 stainless steel, minimum Fy=40 ksi.
2. Post Material: Wood posts provided by others.
3. Post Size: 1-1/2 inch (38.1 mm) x 1-1/2 inch (38.1 mm).
4. Post Size: Tubing for posts as provided by others.
5. Post Mounting Configuration: Top mount, as indicated on installation Drawings.
6. Post Mounting Configuration: Side mount, as indicated on installation Drawings.
7. Post Mounting Configuration: As indicated on Drawings.

C. Top Rails:
1. Top Rail Material: ASTM A 554, Type A316 stainless steel, minimum Fy=40 ksi.
2. Top Rail Material: Wood top rails provided by others.
3. Top Rail Shape, Size: Round, 1-5/8 inch (15.8 mm) diameter x 16 gauge tubing.
4. Top Rail Shape, Size: Flat, 1/2 inch (12.7 mm) x 2 inch (50.8 mm) x 16 gauge tubing.
5. Top Rail Shape, Size: Elliptical, 1-1/16 inch (27 mm) x 1-31/32 inch (50 mm) x 16 gauge tubing.
6. Top Rail Shape, Size: Wood top rails provided by others.

D. Infill - Cables:
1. Material: ASTM A 492, stainless steel, Type 316.
2. Construction: 1 X 19.
3. Diameter: 1/8 inch (3 mm) diameter.
4. Lay: Left Hand Lang's.
5. Core: Stainless steel.
6. Option 1: Cable provided in rolls for field cutting and a crimping; requires field attachment of fittings to ends.
7. Option 2: Cables provided in lengths approximately six inches longer than required for their designated run with fitting attached at one end; requires one end of each length of cable to be field cut and fittings field attached.
8. Option 3: Cable provided cut to length with fittings attached at both ends. (Not Available for Stairs)
9. Cable Fitting Materials: Stainless steel, Type 316.
10. Cable Attachments: Factory, machine swaged.
11. Cable Attachments: Field, hand swaged.
12. Tensioning Method: Threaded terminals.

E. Infill - Glass Panel:
1. Clamps:
a. Material: Type A316 stainless steel.
b. Mounting Bolts: 5/16 inch (8 mm) diameter.
c. Size: Suitable for 1/4 inch (6 mm) or 3/8 inch (9.5 mm) thick glass as applicable.
2. Glass Panels: Provided under the Glazing specification section; not provided

by railing system manufacturer.

F. Infill - Horizontal Round Bars:
   1. Bars: A316 5/8 inch (8 mm) diameter x 16 ga. stainless steel tubing with #4 finish.
   2. Infill tubes are horizontal or sloped to match finished floor.
   3. Installation: Infill tube end connections achieved with proprietary A316 SS hardware.
   4. Intermediate Connections: Proprietary ABS hardware.

G. Hardware: Stainless steel construction; separate dissimilar materials with bushings, grommets or washers to prevent electrolytic corrosion.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.

B. Do not proceed with installation until substrates have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Commencement of installation constitutes acceptance of conditions.

3.2 INSTALLATION

A. Install railing system plumb, level, and true and in accordance with manufacturer's installation instructions and recommendations.

B. Do not tighten the cables more than what is necessary to eliminate any sag.

C. Provide anchorage devices and fittings to secure to in-place construction to adjacent construction. Separate dissimilar materials with bushings, grommets or washers to prevent electrolytic corrosion.

D. Do not cut components, except for cable as required for installation, or abrade component finishes. Field touch-up of finishes only acceptable if done as per manufacturer's recommendations. Return components with damaged finishes to shop for required alterations according to manufacturer's return policy, followed by complete refinishing or provide new components.

E. Secure mounting brackets to building structure in a positive manner using manufacturer recommended reinforcement and anchorage methods for substrate conditions. Locate brackets and hardware at spacing required to support structural loads.

F. Installation of railing system shall be rigid and secure, installed by mechanics experienced in erection of architectural metal. Mounting hardware shall be drawn up tightly. Rails shall be set plumb and aligned.

END OF SECTION

SECTION 061000 - ROUGH CARPENTRY

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. Framing with dimension lumber.
   2. Framing with engineered wood products.
   3. Rooftop equipment bases and support curbs.
   4. Wood furring and grounds.

B. Related Requirements:

C.
   1. Section 061600 "Sheathing."
   2. Section 313116 "Termite Control" for site application of borate treatment to wood framing.

1.3 DEFINITIONS

A. Exposed Framing: Framing not concealed by other construction.

B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.

C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
   1. NeLMA: Northeastern Lumber Manufacturers' Association.
   2. NLGA: National Lumber Grades Authority.
   3. RIS: Redwood Inspection Service.
   4. SPIB: The Southern Pine Inspection Bureau.
   5. WCLIB: West Coast Lumber Inspection Bureau.
   6. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

A. 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.

B. Evaluation Reports: For the following, from ICC-ES:
1. Wood-preservative-treated wood.
2. Engineered wood products.
3. Shear panels.
4. Power-driven fasteners.
5. Powder-actuated fasteners.
6. Expansion anchors.
7. Metal framing anchors.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: 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. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
   3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
   4. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less, 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

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, 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. 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 all rough carpentry unless otherwise indicated.
   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 (460 mm) above the ground in crawlspaces or unexcavated areas.
   5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 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.
   7. Utility shelving.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and the following species:
   1. Hem-fir (north); NLGA.
   2. Mixed southern pine; SPIB.
   3. Spruce-pine-fir; NLGA.
   4. Hem-fir; WCLIB or WWPA.
   5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
   6. Western woods; WCLIB or WWPA.
   7. Northern species; NLGA.
   8. Eastern softwoods; NeLMA.

C. For utility shelving, provide lumber with 15 percent maximum moisture content.

D. For concealed boards, provide lumber with 15 percent maximum moisture content.

E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1,, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.5 FASTENERS

A. 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.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
   1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
   2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.6 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide 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.

C. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those of products of manufacturers listed. 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.

D. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
   1. Use for interior locations unless otherwise indicated.

E. 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 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
   1. Use for wood-preservative-treated lumber and where indicated.

F. Stainless-Steel Sheet: ASTM A 666, Type 304.
   1. Use for exterior locations and where indicated.

2.7 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
   1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesives 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."

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. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

E. Shear Wall Panels: Install shear wall panels to comply with manufacturer's written instructions.

F. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

G. Do not splice structural members between supports unless otherwise indicated.

H. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
   1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

I. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
   1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
   2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- (38-mm actual-) thickness.
   3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
   4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.

J. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

K. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
   1. Use inorganic boron for items that are continuously protected from liquid water.
   2. Use copper naphthenate for items not continuously protected from liquid water.

L. 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. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
   3. 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.

M. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

N. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
   1. Comply with approved fastener patterns where applicable. Before fastening, mark fastener locations, using a template made of sheet metal, plastic, or cardboard.

2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

3.3 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 wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 062000 - FINISH CARPENTRY

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Samples for mouldings.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and grading rules of inspection agencies certified by American Lumber Standards Committee Board of Review.

B. MDF: ANSI A208.2, Grade 130, made with binder containing no urea-formaldehyde resin.

C. Particleboard: ANSI A208.1, M-2, made with binder containing no urea-formaldehyde resin.

D. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

2.2 INTERIOR STANDING AND RUNNING TRIM

A. Interior Softwood Lumber Trim: Finish or 1 Common (Colonial) eastern white, Idaho white, lodgepole, ponderosa, or sugar pine .

1. Maximum Moisture Content: 19 percent.

B. Wood Moldings: WMMPA WM 4 made to patterns in WMMPA WM 12 from kiln-dried stock.

1. Moldings for Painted Finish: P-Grade eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine or primed medium-density fiberboard.
2. Base: See drawings.
3. Casing: See drawings.
4. Chair Rail: See drawings.

2.3 SHELVING AND CLOTHES RODS

A. Shelving: White, coated steel wire shelving with integral rod by Rubbermaid or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Condition finish carpentry in installation areas for 24 hours before installing.

B. Install finish carpentry level, plumb, true, and aligned with adjacent materials. Scribe and cut to fit adjoining work. Refinish and seal cuts.

C. Install standing and running trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Stagger joints in adjacent and related trim. Cope at returns and miter at corners.

END OF SECTION 062000

SECTION 064100 – CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pre-manufactured plastic laminate casework and countertops to be installed on pre-manufactured casework.

B. Related Sections include the following:

1. Division 22 Section “Common Work Results for Plumbing” for sink units mounted in countertops.

1.2 SUBMITTALS

A. Product Data: For each type of casework specified.

B. Product Data: For each type of hardware specified.

C. Shop Drawings: For casework showing location and size, accessories, materials, finishes, and filler panels. Include fully dimensioned plans, elevations, and anchorage details to countertop and walls.

D. Shop Drawings: For countertops showing sizes, shapes, edge and backsplash profiles, cutouts for plumbing fixtures, and methods of joining.

E. Samples for Initial Selection Purposes: In the form of manufacturer’s color charts consisting of sections of units showing full range of colors, textures, and patterns available for each type of material indicated or exposed to view.

1.4 QUALITY ASSURANCE

A. Source Limitations: Provide casework with tops manufactured or furnished by same plastic laminate casework manufacturer for single responsibility.

B. Product Options:

1. This work includes special and modified stock design pre-assembled units for installation as movable, fixed, or built-in, as indicated.
2. The catalog numbers of the manufacturer listed on the drawings are intended to include a complete and total item, as the catalog number is specified in the manufacturer’s current catalog. Although the description in the schedule is brief,

the item shall be provided complete with hardware, accessories, features, and components.

3. Provide labor, materials, and equipment necessary for the complete installation of educational casework as indicated.
4. The use of dimensions and specific requirements set forth in Drawings and Specifications are not intended to preclude the use of other acceptable manufacturer's products or procedures which may be equivalent, but are given for purpose of establishing standard for design and quality for materials, construction, and workmanship.
5. Cabinets indicated to receive sinks shall be constructed to allow for installation of sinks for sizes indicated. Coordinate with Division 22, "Common Work Results for Plumbing" for sizes.
6. General millwork, blocking within walls, floors, or ceilings required for reinforcement and support, rubber base, electrical outlets and stainless steel sinks and fittings are work which is not included.
7. Workmanship: Defective workmanship or damaged components shall be corrected, repaired, or replaced, as requested by the Architect, without further cost to the Owner.
8. Manufacturer Qualifications: At least 7 years experience in the manufacture and installation of the type of cabinets specified.
9. Installer Qualifications: At least 5 years experience in the installation of the type of cabinets specified and approval by manufacturer.
10. Quality Standards: Manufactured casework systems must conform to design, quality of materials, workmanship and function as indicated. Minimum quality standards shall be custom grade in accordance with AWI Section 1600 B with additional requirements herein.

1.5 DEFINITIONS

A. Exposed Portions of Casework: Include surfaces visible when doors and drawers are closed. Bottoms of casework more than 4 feet above floor and tops less than 6 feet 6 inches above floor shall be considered as exposed. Visible members in open cases or behind glass doors also shall be considered as exposed portions.

B. Semi-Exposed Portions of Casework: Includes those members behind opaque doors, such as shelves, divisions, interior faces of ends, case back, drawer sides, backs and bottoms, and back face of doors. Tops of casework 6 feet 6 inches or more above floor shall be considered semi-exposed.

C. Concealed Portions of Casework: Include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.

1.6 SYSTEM DESCRIPTION

A. Accessibility Requirements

1. Casework shall be provided to conform with the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and State and Local regulations. These requirements supersede Technical Specifications in this Section.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Do not deliver casework to project site until dry and heated storage space is provided. The casework specified under this Section is pre-finished and precaution must be taken to protect it against damage during installation and until final acceptance.

B. Quantities Verification: Contractor shall be responsible for quantities as shown on casework layouts on Drawings.

C. Field Measurements: The manufacturer/supplier shall be responsible for making field measurements to insure proper fit of casework items.

1.8 GUARANTEE

A. Warranty: The entire installation shall be guaranteed for a period of 3 years from the date of Substantial Completion against defects in material and workmanship in accordance with terms of the Contract. The guarantee shall cover repair or replacement, without cost to the Owner, of items which become defective within the 3 year period. Damage to the equipment caused by improper operation or misuse is not covered by this guarantee.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Casework: Products of the following manufacturers are acceptable as a basis of quality for the casework and equipment specified herein. Minor differences in construction and products incorporated into the cabinetry are recognized to exist and may be acceptable. These variations must be submitted to the Architect at least 10 days prior to bid due date. Acceptance will be established by Addendum. However, manufacturers capable of providing specified products shall not, for convenience of their normal production methods, vary from specified products.

1. Stevens Industries Inc.- Teutopolis, IL
2. TMI Systems Design Corporation, Dickinson, North Dakota
3. Westmark Products, Inc. Tacoma, Washington
5. HLF Furniture Inc., Bellerville, Michigan

2.2 MATERIALS

A. Plastic Laminate:

1. Plastic laminate shall be high pressure laminate conforming to NEMA LD3-1991. Density shall be 90 pounds per cubic foot minimum for all grades.
2. Laminates shall be chosen from current Wilsonart or Formica Brand. Series of all solid color and patterned laminate materials with low luster textured finish. Color shall be selected by Architect to match existing.
3. Countertops: Shall be nominal .050 inch thick minimum with textured finish and conforming to NEMA standards for GP50 horizontal grade.
4. Exposed horizontal surfaces except countertops: Shall be nominal .028 inch thick minimum with low luster textured finish and conforming to NEMA standards for GP28 horizontal grade.
5. Exposed interior and exterior vertical surfaces: Shall be .028 inch thick minimum with low luster textured finish and conforming to NEMA Standards for GP28 vertical grade.
6. Semi-exposed surfaces, except shelves: Shall be .020 inch thick CL20 cabinet liner conforming to NEMA standards or melamine.
7. Shelves: Shall be .028 inch thick minimum with low luster textured finish and conforming to NEMA standards for GP28 horizontal grade.
8. Backing sheet on concealed surfaces: Shall be .020 inch thick, conforming to NEMA standards for CL20 cabinet liner. Use to balance face laminate.
9. Backing sheet for countertops: Shall be .020 inch minimum thickness and conforming to NEMA standards for BK20.
10. Color of Laminate

    a. Exposed Exterior: As selected by Architect from full complement of choices
    b. Exposed Interior: White
    c. Semi-Exposed: As selected by Architect from standard colors
    d. Concealed Exterior: As selected by Architect from standard colors

B. Melamine

1. Melamine shall be saturated paper laminated to core. Weight of paper shall not be less than 80 grams.
2. Semi-Exposed Surfaces: Melamine shall conform to NEMA LD3-3.1-1991 for wear requirements for GP28 vertical grade.
3. Color of melamine: To be selected by Architect

C. Leading Edges

1. Door and drawer fronts shall be edged with a nominal 3 mm thick high impact PVC extrusion, with satin finish. Edges shall be machine applied with waterproof hot melt adhesive.
2. Horizontal and vertical front cabinet members shall be flat edged with a nominal 1 mm thick high impact PVC extrusion, with a satin finish.
3. Color of PVC leading edges:

a. Open Units: Shall match exterior plastic laminate color
b. Horizontal and Vertical Front Cabinet Members: Shall match exposed plastic laminate color or as selected by Architect
c. Semi-Exposed Locations: Shall match interior plastic laminate color
d. Drawer and Door Fronts: As selected from colors to match plastic laminate, or as selected by Architect

D. Particleboard

1. Cabinets: Provide premium industrial grade, conforming to ANSI A208.1, type M-3, minimum standards with the following categories upgraded:

a. Density, lb. per cu. ft	47
b. Moisture content percent by weight	6.0
c. Screw holding	
(1) Face	330
(2) Edge	250
d. Hardness lb.	900

2. Countertops with sinks: Provide shop sanded exterior grade veneer core plywood or phenolic resin particleboard, Type 2-M-2 or 2-M-3.

E. Hardboard: Hardboard used in the cabinets whether exposed or semi-exposed shall be ANSI A135.4, Class 1 tempered, smooth, 2 sides equal to “Duron” by U.S. Gypsum Company.

F. Plywood, Hardwoods: Solid lumber or plywood concealed members, solid wood to be hardwood, kiln-dried, select poplar, fir, or mill option lumber and plywood shall be Baltic Birch 7-ply.

G. Locks: Locks shall be cylinder type cast with 5 disc tumbler mechanism. Each lock shall be provided with 2 milled brass keys. Locks shall be keyed as required by Owner. Provide master key (s) for each room. Locks shall be provided as shown on equipment drawings or described in cabinet description. Each area or room shall be keyed alike.

2.3 HARDWARE AND MISCELLANEOUS

A. Hinges: Institutional 5 knuckle with interlaying leaves capable of 270 degree swing. They shall be of nominal .090 inch minimum thickness steel and shall be hospital tipped with non-removable pins fastened with 4 screws each leaf into faces. No edge fastening allowed.

1. Finish: Electrostatically powder coated and baked. Color to be selected by Architect.

B. Pulls: Shall be accurately positioned on drawer and door fronts and positively through fastened with machine screws.

1. Bent wire, molded nylon: Similar to Hewi # 548.06. Color to be selected by Architect.
2. Finish: Electrostatically powder coated and baked. Color to be selected by Architect.

C. Drawer Slides:

1. Provide manufacturer's standard, epoxy coated metal, nylon rollers, 100 pounds dynamic loading, and with positive in-stop and out-stop.
2. Provide out-stop and out-keeper to maintain drawer in 80 percent open position.
3. File drawers and paper storage drawers: Same as above, except full extension and load rating static position to be no less than 125 pounds, Blum No. BS 430E or K & V #8400.

D. Adjustable Shelf Supports: Molded nylon or nickel, 2 pin, anti-lift, minimum 200 pound capacity support clip.

E. Catches: All doors shall have either roller type or magnetic type.

1. Manufacturer's standard roller catch equivalent to LSI "LH-345" catch assembly
2. Manufacturer's standard magnetic type, meeting handicap requirements for pounds of pull required to open doors. Two required for doors over 48 inches in height, positioned at top and bottom.

F. Plastic tote tray dividers shall be pre-finished ¼ inch thick tempered hardboard.

G. Cubicle cabinet dividers shall be ¾ inch particleboard with laminate on both sides.

H. Tote Trays: Molded high impact plastic with card holder on front.

I. Cable Hole Covers: High impact ABS cable hole cover, 1 ½ inch inside diameter, with spring closure in top. Color as selected by Architect. Refer to Drawings for locations. Manufactured by Hafele.

2.4 WORKMANSHIP - GENERAL

A. Machine parts for accurate fit and assemble with appropriate fastenings and adhesives to result in true, square, level and plumb units.

B. Verify dimensions of other trades to be built into casework.

C. Provide removable or false backs for access or concealment of heating or plumbing items.

D. Scribe tops and backsplashes to walls and other adjoining vertical surfaces.

E. There shall be a 1 ½ inch maximum scribe with cabinets at end walls unless shown otherwise.

2.5 CABINET CONSTRUCTION

A. Cabinet Bases

1. Manufacturer's standard 4 inch high base construction of water repellent treated, ¾ inch plywood or industrial grade particleboard. Recess base ¼ inch at exposed ends to receive 4 inch rubber vinyl base. Provide additional center support for cabinets over 24 inches wide.

B. Base, Wall and Tall Cabinet Boxes

1. Sides, bottom and top: Constructed of glued and spline doweled ¾ inch particleboard, providing balanced construction, surfaced with cabinet liner CL20 or melamine for semi-exposed locations and vertical grade laminate for exposed locations.

2. Wall cabinet bottoms and tops: Constructed of glued and spline doweled one inch thick particleboard, providing balanced construction surfaced with vertical grade laminate for exposed locations and cabinet line CL20 or melamine for semi-exposed location.

3. Back Panel: Constructed of minimum 3/8 inch particleboard or ¼ inch pre-finished tempered hardboard, surfaced with cabinet liner CL20 or melamine for semi-exposed locations and vertical grade laminate for exposed locations, inset and glued into sides, bottom, and top.

4. Exposed Backs: Constructed of ¾ inch particleboard, surfaced with vertical grade laminate of balanced construction, glued and spline doweled, and mechanically attached if required.

5. Intermediate Support Rail: Minimum ¾ inch particleboard, surfaced with vertical grade laminate of balanced construction, glued and doweled into cabinet sides.

6. Hanger Rails: Two located at top and bottom of cabinet back, 3 on tall cabinets, locate at top, bottom, and center, ¾ inch particleboard.

7. Clear inside depth of wall cabinets shall be 12 inches, minimum. See Drawings for depths.

C. Fixed and Adjustable Shelves and Dividers

1. One inch particleboard shelves.
2. Exposed Locations: Vertical grade plastic laminate both sides. Color to match cabinet exterior plastic laminate or as selected by Architect.
3. Semi-Exposed Locations: Vertical grade plastic laminate both sides.

4. Front and back leading edges shall be edged with flat 1 mm thick high impact PVC edging to match shelf color.
5. Number of adjustable shelves provided, unless indicated otherwise on the Drawings.

   a. Tall Cabinets
      3 up to 60 inches 5 up to 84 inches
      4 up to 72 inches 6 up to 96 inches

   b. Base Cabinets
      1 up to 36 inches

   c. Wall Hung Cabinets
      0 up to 24 inches 2 up to 36 inches
      1 up to 30 inches 3 up to 40 inches

6. Adjustable Dividers: ¼ inch minimum thickness, pre-finished tempered hardboard or plywood, smooth both faces, retained by molded plastic support clip.
7. Fixed Dividers: Constructed of ¾ inch particleboard, surfaced with vertical grade laminate for exposed locations and cabinet liner CL20 for semi-exposed locations; glued and spline doweled. PVC edged to match laminate or adjacent PVC edging.

D. Cabinet Doors

1. Doors shall be reveal overlay style.
2. Hinged Doors

   a. ¾ inch particleboard
   b. High pressure plastic vertical grade laminate exterior and CL20 cabinet liner interior surface.
   c. Doors 48 inches and less in height shall have 2 hinges per door, doors over 48 inches in height shall have 3 hinges per door.

3. Corners: Square with radiused edges, 3 mm PVC edging.

E. Drawers

1. Manufacturer's standard construction of minimum components listed below:

   a. Constructed of minimum ½ inch particleboard, plywood, hardwood lumber, or high density fiber board; glued and doweled or dovetail jointed; surfaced with vertical grade laminate or melamine of balanced construction. Bottoms constructed of minimum ¼ inch tempered hardboard, surfaced to match drawer sides, inset and glued to four sides. Reinforce bottoms on wide drawers with front to back inset stiffeners, 1 at 24 inch wide drawers, 2 at 36 inch and 4 at 48 inch; glue, fasten, and seal perimeter with hot melt adhesive.

2. Drawer Face

a. Constructed of minimum ¾ inch particleboard, surfaced with high pressure vertical grade laminate exterior and interior, screw attached to the drawer box.

(1) Corners: To match doors
(2) Edging: To match doors
(3) Plastic Laminate: To match doors

3. File Drawers

a. File drawers shall be constructed in accordance with 1 and 2 above. File drawers shall have front–to-back and side-to-side hanger file capability with hanger channel for letter size files integral with file drawer sides. 3/16 inch by ½ inch removable steel channel to span side-to-side for legal size hanging files.

2.6 SOLID SURFACE COUNTERTOPS

2.6 MANUFACTURERS

A.
1. Dupont – Corian
2. Wisonart - Gibralter
3. Formica - Formica Solid Surfacing
4. LG Hausys – Acrylic Solid Surface

B. ½” thick for countertops, installed over particleboard backer, 1” total thickness. ½” minimum Type 1-M-2 medium density particle board.

C. ½” thick for edge banding, provide a face deprth of 1”, unless noted otherwise.

D. ½” for backsplashes and end splashes, 4” high.

E. Bullnose Edge Configurations

F. Provide countertops for base cabinets and counter sections.

G. Solid Surface tops shall be continuous in practical lengths. When requiring splice joints, use fasteners as required to make a uniform and gapless joint.

1. Provide continuous top for counter type cabinets fixed in a line.

H. Provide 4 inch high scribable, square set, color matching backsplash with endsplashes.

1. Backsplashes are required at locations where countertops abut walls.
2. Edges of back and endsplashes shall be of square edge configuration.

I. Sealants: Fully bed and seal splashes to tops and to other splashes with Dow Corning 786 Mildew Resistant Silicone Sealant, clear.

PART 3 - EXECUTION1

3.1 INSTALLATION

A. Shop Drawings and installation instructions furnished by the manufacturer shall be strictly adhered to. Mechanics making the installation shall be experienced in this type of work and capable of the highest quality of workmanship.

B. Countertops shall be installed flush against wall. Provide clear sealant at top and around ends of countertops, endsplashes, and backsplashes where they meet wall surfaces.

C. Cut openings in countertops for sinks or other items required. Cut to size from template furnished by supplier of sinks or use the designated sinks on job.

D. Make use of filler sections and scribe panels to fit cabinet work into specific dimensions.

E. Provide maintenance instructions to Owner prior to request for final payment.

3.2 ADJUSTMENT

A. Adjust door catches, drawer slides, and other moving parts after installation to provide proper operation.

B. End cabinets placed against corners where they tee into other cabinets or obstacle shall be provided with bracket stops on the inside of the doors to prevent the door or door handles from hitting the obstruction.

3.3 CLEANING

A. Exposed surfaces, edges, and cabinet interiors shall be cleaned, and construction and installation marks removed prior to acceptance by Owner.

B. Supplier of this equipment shall be responsible for the immediate removal and disposal of trash, crating, and construction debris.

END OF SECTION 123240

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Foam-plastic board insulation.
   2. Glass-fiber blanket insulation.
   3. Loose-fill insulation.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 518, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
   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:
   2. Type I, 25 psi.
   3. Cavity Insulation –Thermax ci , 2” thick, R13 or
   4. Hunter Xci CG, 2” thick

2.2 GLASS-FIBER BLANKET INSULATION

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. CertainTeed Corporation.
   2. Guardian Building Products, Inc.
   3. Johns Manville.
   4. Knauf Insulation.
   5. Owens Corning.
   6. Or equal.

B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

C. Polypropylene-Scrim-Kraft-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (non-reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).

D. Kraft-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (non-reflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).

E. Reinforced-Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

F. Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

2.3 LOOSE-FILL INSULATION

A. Perlite insulation at all exterior concrete block cores.

2.4 VAPOR RETARDERS

A. Polyethylene Vapor Retarders: ASTM D 4397, 15 mils thick.

B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.2 INSTALLATION OF BELOW-GRADE INSULATION

A. On vertical footing and foundation wall surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
   1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) below exterior grade line.

B. On horizontal surfaces under slabs, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
   1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) in from exterior walls.

3.3 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

3.4 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
   3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
   4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
   5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
   6. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:

a. With faced blankets having stapling flanges, secure insulation by inset, stapling flanges to sides of framing members.
b. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

7. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.
   a. Exterior Walls: Set units with facing placed toward as indicated on Drawings.
   b. Interior Walls: Set units with facing placed toward areas of high humidity.

D. Loose-Fill Insulation: Apply according to ASTM C 1015 and manufacturer's written instructions. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.
   1. For cellulosic-fiber loose-fill insulation, comply with CIMA's Bulletin #2, "Standard Practice for Installing Cellulose Insulation."

E. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
   1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.5 INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

A. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
   1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
   2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
   3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
   4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.6 INSTALLATION OF VAPOR RETARDERS

A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

C. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

END OF SECTION 072100

SECTION 075423 - THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanically Fastened TPO membrane roofing system.

1.2 PERFORMANCE REQUIREMENTS

A. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

B. Energy Performance: Provide roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low -slope roof products.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For the following products:

1. Sheet roofing, of white color.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of compliance with performance requirements.

B. Research/evaluation reports.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product.

B. Source Limitations: Obtain components including roof insulation for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.

C. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

D. Preinstallation Roofing Conference: Conduct conference at Project site.

1.7 WARRANTY (Membrane only)

A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TPO MEMBRANE ROOFING

A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible TPO sheet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlisle SynTec Incorporated.
b. Custom Seal Roofing.
c. Firestone Building Products Company.
d. GAF Materials Corporation.
e. GenFlex Roofing Systems.
f. Johns Manville.
g. Mule-Hide Products Co., Inc.
h. Stevens Roofing Systems; Division of JPS Elastomerics.
i. Versico Incorporated.

2. Thickness: 60 mils, nominal.

2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Plastic Foam Adhesives: 50 g/L.
b. Gypsum Board and Panel Adhesives: 50 g/L.
c. Multipurpose Construction Adhesives: 70 g/L.
d. Fiberglass Adhesives: 80 g/L.
e. Single-Ply Roof Membrane Adhesives: 250 g/L.
f. Other Adhesives: 250 g/L.
g. Single-Ply Roof Membrane Sealants: 450 g/L.
h. Nonmembrane Roof Sealants: 300 g/L.
i. Sealant Primers for Nonporous Substrates: 250 g/L.
j. Sealant Primers for Porous Substrates: 775 g/L.

B. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 55 mils thick, minimum, of same color as sheet membrane.

C. Bonding Adhesive: Manufacturer's standard.

D. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.

F. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.3 ROOF INSULATION

A. Polyisocyanurate Board Insulation: See Specification Section 072100.

B. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.4 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof

insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended cold-applied adhesive formulated to attach roof insulation to substrate or to another insulation layer.

C. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/4 inch.

2.5 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch thick, and acceptable to membrane roofing system manufacturer.

PART 3 - EXECUTION

3.1 INSULATION INSTALLATION

A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

E. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

F. Mechanically Fastened and Adhered Insulation: Install each layer of insulation and secure first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
2. Set each subsequent layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
3. Set each subsequent layer of insulation in adhesive, firmly pressing and maintaining insulation in place.

G. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together.

1. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

3.2 ADHERED MEMBRANE ROOFING INSTALLATION

A. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.

B. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

C. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.

D. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing.

E. Apply membrane roofing with side laps shingled with slope of roof deck where possible.

F. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

3.3 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.4 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

END OF SECTION 075423

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data, Shop Drawings, and color Samples.

B. Warranties: Provide manufacturer's standard written warranty, signed by manufacturer agreeing to promptly repair or replace roof specialties that show evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper as recommended by manufacturer for use and finish indicated.

C. Aluminum Finish: Two-coat fluoropolymer system with color coat containing not less than 70 percent PVDF resin by weight.

D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, No. 2B (bright, reflective) finish.

E. Prepainted, Zinc-Coated Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation, structural quality, and coil coated prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Finish: Manufacturer's standard two-coat fluoropolymer system with color coat containing not less than 70 percent PVDF resin by weight; complying with AAMA 621.

F. Felt Underlayment: ASTM D 226, Type II (No. 30), asphalt-saturated organic felts.

G. Self-Adhering Sheet Underlayment, High Temperature: Butyl or SBS-modified asphalt; slip-resisting-polyethylene surfaced; with release paper backing; cold applied. Stable after testing at 240 deg F (116 deg C) and passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.

1. Products: One of the following:

a. Carlisle Coatings & Waterproofing; CCW WIP 300HT.
b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
c. Henry Company; Blueskin PE200 HT.
d. Metal-Fab Manufacturing, LLC; MetShield.
e. Owens Corning; WeatherLock Metal High Temperature Underlayment.

H. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements.

1. Exposed Penetrating Fasteners: Gasketed screws with heads matching color of metal.
2. Fasteners for Copper Sheet: Copper, hardware bronze, or Series 300 stainless steel.
3. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
5. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel.

I. Butyl Sealant: ASTM C 1311, solvent-release butyl rubber sealant.

J. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

ROOF SPECIALTIES

K. SPRI Wind Design Standard: Provide copings and roof-edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: 90 MPH.

L. Cornice: EIFS foam. Decorative cornice moldings shall be EPS foam with design approved by architect.

M. Copings: Manufactured coping system consisting of formed-metal coping cap, concealed anchorage; corner units, end cap units, and concealed splice plates.

1. Manufacturers: One of the following:
2. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

a. Architectural Products Company.
b. ATAS International, Inc.
c. Castle Metal Products.
d. Cheney Flashing Company.
e. Hickman Company, W. P.
f. Johns Manville.
g. Merchant & Evans, Inc.
h. Metal-Era, Inc.
i. Metal-Fab Manufacturing, LLC.
j. MM Systems Corporation.

k. National Sheet Metal Systems, Inc.
l. Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.
m. Petersen Aluminum Corporation.

3. Formed Aluminum: 0.050 inch (1.27 mm) thick.
4. Prepainted, Zinc-Coated Steel: 0.028 inch (0.71 mm) thick.

N. Canted Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover and a continuous formed galvanized-steel sheet cant, 0.028 inch (0.71 mm) thick, minimum, with extended vertical leg terminating in a drip-edge cleat.

1. Manufacturers: One of the following:
2. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

a. Architectural Products Company.
b. ATAS International, Inc.
c. Cheney Flashing Company.
d. Hickman Company, W. P.
e. Johns Manville.
f. Metal-Era, Inc.
g. Metal-Fab Manufacturing, LLC.
h. MM Systems Corporation.
i. Petersen Aluminum Corporation.

3. Aluminum: 0.050 inch (1.27 mm) thick.
4. Prepainted, Zinc-Coated Steel: 0.028 inch (0.71 mm) thick.

O. Gutters and Downspouts:

1. Manufacturers: One of the following:

a. Andreas Renner KG.
b. Architectural Products Company.
c. ATAS International, Inc.
d. Berger Building Products, Inc.
e. Castle Metal Products.
f. Cheney Flashing Company.
g. CopperCraft by FABRAL; a Euramax company.
h. Hickman Company, W. P.
i. Klauer Manufacturing Company.
j. Merchant & Evans, Inc.
k. Metal-Era, Inc.
l. Metal-Fab Manufacturing, LLC.
m. MM Systems Corporation.
n. National Sheet Metal Systems, Inc.
o. Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.

2. Gutters: Manufactured in uniform section lengths, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch (25 mm) above front edge. Furnish expansion joints, and expansion-joint covers.

   a. Gutter Style: Rectangular.
   b. Aluminum: 0.050 inch (1.27 mm) thick.
   c. Prepainted, Zinc-Coated Steel: 0.028 inch (0.71 mm) thick.
   d. Gutter Supports: Gutter brackets, Straps, Spikes, and ferrules with finish matching the gutters.

3. Downspouts: Plain rectangular with mitered elbows. Furnish wall brackets of same material and finish as downspouts, with anchors.

   a. Formed Aluminum: 0.050 inch (1.27 mm) thick.
   b. Extruded Aluminum: 0.125 inch (3.18 mm) thick.
   c. Prepainted, Zinc-Coated Steel: 0.028 inch (0.71 mm) thick.

P. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces. Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
   1. Formed Aluminum: 0.050 inch (1.27 mm) thick.
   2. Stainless Steel: 0.019 inch (0.48 mm) thick.
   3. Zinc-Coated Steel: Nominal 0.022-inch (0.56-mm) thickness.

Q. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped. CONTRACTOR TO TAKE MEASURES TO ENSURE DISSIMILAR MATERIALS SHALL NOT REACT AND BREAK DOWN AT ALL FLASHING/COUNTERFLASHING LOCATIONS.

   1. Copper: 16 oz./sq. ft. (0.55 mm thick).
   2. Formed Aluminum: 0.024 inch (0.61 mm) thick.
   3. Stainless Steel: 0.019 inch (0.48 mm) thick.
   4. Zinc-Coated Steel: Nominal 0.022-inch (0.56-mm) thickness.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement.

B. Coat back side of aluminum and/or stainless steel roof specialties with bituminous coating where they will contact wood, ferrous metal, or cementitious construction.

C. Separate dissimilar metals with a bituminous coating or polymer-modified, bituminous sheet underlayment.

D. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

E. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless indicated.

1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet (15.2 m) apart. Install expansion joint caps.

F. Fastener Sizes: Use fasteners of sizes that will penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except where pretinned surface would show in finished Work.

H. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 12 inches (305 mm) apart. Attach ends with rivets and seal with sealant and/or solder in order to make watertight. Slope to downspouts.

I. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c.

J. Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches (100 mm) over top edge of base flashings.

END OF SECTION 077100

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and product certificates signed by manufacturer certifying that products furnished comply with requirements.

B. Provide firestopping systems with fire-resistance ratings indicated by reference to UL designations as listed in its "Fire Resistance Directory," or to designations of another testing agency acceptable to authorities having jurisdiction.

C. Provide through-penetration firestopping systems with F-ratings indicated, as determined according to ASTM E 814, but not less than fire-resistance rating of construction penetrated.

1. Provide through-penetration firestopping systems with T-ratings as well as F-ratings, as determined according to ASTM E 814, where indicated.

D. For exposed firestopping, provide products with flame-spread indexes of less than 25 and smoke-developed indexes of less than 450, as determined according to ASTM E 84.

PART 2 - PRODUCTS

2.1 FIRESTOP SYSTEMS

A. Available Products:

1. Specified Technologies, Inc., Pen 300 Silicone Sealant,or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install firestopping systems to comply with requirements listed in testing agency's directory for indicated fire-resistance rating.

B. Identification: Identify through-penetration firestop systems with permanent labels attached to surfaces adjacent to firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb."

2. Classification/listing designation of applicable testing and inspecting agency.
3. Through-penetration firestop system manufacturer's name and product name.
4.

END OF SECTION 078413

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Silicone joint sealants.
   2. Urethane joint sealants.
   3. Latex joint sealants.
   4. Preformed joint sealants.
   5. Acoustical joint sealants.

1.2 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers eight samples of materials that will contact or affect joint sealants. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples: For each kind and color of joint sealant required.

C. Joint-Sealant Schedule: Include the following information:
   1. Joint-sealant application, joint location, and designation.
   2. Joint-sealant manufacturer and product name.
   3. Joint-sealant formulation.
   4. Joint-sealant color.

D. Product test reports.

E. Preconstruction compatibility and adhesion test reports.

F. Preconstruction field-adhesion test reports.

G. Field-adhesion test reports.

H. Warranties.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

B. Preinstallation Conference: Conduct conference at Project site.

1.5 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Insert number years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
   1. Architectural Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
   1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

2.2 SILICONE JOINT SEALANTS

A. Mildew-Resistant Silicone Joint Sealant: ASTM C 920.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BASF Building Systems.
      b. Dow Corning Corporation.
      c. GE Advanced Materials - Silicones.
      d. May National Associates, Inc.
      e. Pecora Corporation.
      f. Polymeric Systems, Inc.
      g. Schnee-Morehead, Inc.
      h. Sika Corporation; Construction Products Division.
      i. Tremco Incorporated.
      j.
   2. Type: Single component (S).
   3. Grade: nonsag (NS).
   4. Class: 25.
   5. Uses Related to Exposure: Applications around countertops, backsplashes, and other wet locations..

2.3 URETHANE JOINT SEALANTS

A. Urethane Joint Sealant: ASTM C 920.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BASF Building Systems.
      b. Bostik, Inc.
      c. Lymtal, International, Inc.
      d. May National Associates, Inc.
      e. Pacific Polymers International, Inc.
      f. Pecora Corporation.
      g. Polymeric Systems, Inc.
      h. Schnee-Morehead, Inc.
      i. Sika Corporation; Construction Products Division.
      j. Tremco Incorporated.
      k.
   2. Type: multicomponent (M).
   3. Grade: nonsag (NS).
   4. Class: 25.
   5. Uses Related to Exposure: Traffic (T) and Nontraffic (NT).

2.4 LATEX JOINT SEALANTS

A. Latex Joint Sealant **LS-1**: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

B. Application: Exposed applications on interior locations involving joint movement of not more than plus or minus 5 percent.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. BASF Building Systems.
   b. Bostik, Inc.
   c. May National Associates, Inc.
   d. Pecora Corporation.
   e. Schnee-Morehead, Inc.
   f. Tremco Incorporated.

2.5 PREFORMED JOINT SEALANTS

A. Preformed Foam Joint Sealant **PS-**1: Manufacturer's standard preformed, precompressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.

B. Applications - At building expansion joints indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Dayton Superior Specialty Chemicals.
      b. EMSEAL Joint Systems, Ltd.
      c. Sandell Manufacturing Co.
      d. Schul International, Inc.
      e. Willseal USA, LLC.
      f.

2.6 ACOUSTICAL JOINT SEALANTS

A. Acoustical Joint Sealant AS-1: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Pecora Corporation.
      b. USG Corporation.
      c. Applications at corridor, adminstration areas, and classroom/lab areas that are the receive ceiling tile.

2.7 JOINT SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant

manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.8 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
   1. Remove laitance and form-release agents from concrete.
   2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

F. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer's written recommendations.

G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.3 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
   1. Extent of Testing: Test completed and cured sealant joints as follows:
      a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
      b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
   2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to

comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and Shop Drawings.

B. Comply with ANSI/SDI A250.8.

C. Fire-Rated Doors and Frames: Labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing per NFPA 252 at positive pressure .
   1. At exit passageways, provide doors that have a temperature rise rating of 450 deg F

D. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cold-Rolled Steel Sheets: ASTM A 1008/A 1008M, suitable for exposed applications.

B. Hot-Rolled Steel Sheets: ASTM A 1011/A 1011M, free of scale, pitting, or surface defects.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, with G40 A40 metallic coating.

D. Frame Anchors: ASTM A 591/A 591M, 4OZ coating designation; mill phosphatized.
   1. For anchors built into exterior walls, sheet steel complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

2.2 HOLLOW METAL DOORS AND FRAMES

A. Available Products:
   1. Amweld, BenchMark, Ceco, Curries, Repulic or Steelcraft.

B. Doors: Complying with ANSI 250.8 for level and model and ANSI A250.4 for physical-endurance level indicated, 1-3/4 inches thick unless otherwise indicated.
   1. Interior Doors: Level 1 and Physical Performance Level C (Standard Duty), Model 2 (Seamless).
   2. Exterior Doors: Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless), metallic-coated steel sheet faces.

a. Thermal-Rated (Insulated) Doors: At all exterior doors, provide doors with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.

3. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as door face sheets.
4. Door Color: TBA

C. Frames: ANSI A250.8; conceal fastenings unless otherwise indicated.
1. Steel Sheet Thickness for Interior Doors: 0.042 inch
2. Steel Sheet Thickness for Exterior Doors: 0.053 inch
3. Fabricate interior frames with welded corners.
4. Fabricate exterior frames from metallic-coated steel sheet, with mitered or coped and continuously welded corners.
5. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.
6. Frame Anchors: Not less than 0.042 inch thick.
7. Frame color: TBA

D. Glazing Stops: Nonremovable stops on outside of exterior doors and on secure side of interior doors; screw-applied, removable, glazing stops on inside, fabricated from same material as door face sheet in which they are installed.

E. Door Louvers: Sight Light proof per SDI 111C.
1. Verify with mechanical plans.

F. Door Silencers: Three on strike jambs of single-door frames and two on heads of double-door frames.

G. Grout Guards: Provide where mortar might obstruct hardware operation.

H. Prepare doors and frames to receive mortised and concealed hardware according to ANSI A250.6 and ANSI A115 Series standards.

I. Reinforce doors and frames to receive surface-applied hardware.

J. Prime Finish: Manufacturer's standard, factory-applied coat of lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install hollow metal frames to comply with ANSI/SDI A250.11.
1. Fire-Rated Frames: Install according to NFPA 80.

B. Install doors to provide clearances between doors and frames as indicated in ANSI/SDI A250.11.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying rust-inhibitive primer. Use galvanizing repair paint for metallic coated surfaces.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Samples for factory-finished doors.

PART 2 - PRODUCTS

2.1 Manufacturers:

A. Marshfield Door Systems, Inc.- or Equivalent

2.2 DOOR CONSTRUCTION, GENERAL

A. Quality Standard: WDMA I.S.1-A.

B. Certified Wood: Wood doors shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

C. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.

D. WDMA I.S.1-A Performance Grade:

1. Heavy Duty unless otherwise indicated.
2. Extra Heavy Duty: Public toilets, Assembly spaces, Exits, Interrogation room
3. Standard Duty: Closets (not including janitor's closets), Offices

E. Particleboard-Core Doors: Provide blocking in particleboard cores or provide structural composite lumber cores instead of particleboard cores for doors with exit devices or protection plates.

2.3 FLUSH WOOD DOORS

A. Doors for Transparent Finish:

1. Interior Solid-Core Doors: Premium grade, seven-ply, particleboard cores.

a. Faces: Grade A rotary-cut select white birch
b. Veneer Matching: Pleasing match.
c. Pair matching and set matching.
d. Finish, Verify with architect prior to ordering.

2.4 LOUVERS AND LIGHT FRAMES

A. Light Frames: Wood beads of same species as door faces.

1. At fire-rated doors provide factory-painted steel frames approved for use in doors of fire-protection rating indicated.

2.5 FABRICATION AND FINISHING

A. Factory fit doors to suit frame-opening sizes indicated and to comply with clearances specified.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3.

C. Cut and trim openings to comply with referenced standards.

1. Trim light openings with moldings indicated.
2. Factory install glazing in doors indicated to be factory finished.
3. Factory install louvers in prepared openings.

D. Factory finish doors indicated for transparent finish with stain and manufacturer's standard finish complying with WDMA TR-4, conversion varnish for grade specified for doors.

1. Sheen: Satin

E. Factory finish doors indicated for opaque finish with manufacturer's standard finish complying with WDMA OP-4, conversion varnish for grade specified for doors.

1. Sheen: Satin

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install doors to comply with manufacturer's written instructions and WDMA I.S.1-A, and as indicated.

1. Install fire-rated doors to comply with NFPA 80.

B. Align and fit doors in frames with uniform clearances and bevels. Machine doors for hardware. Seal cut surfaces after fitting and machining.

C. Clearances: As follows unless otherwise indicated:

1. 1/8 inch at heads, jambs, and between pairs of doors.
2. 1/8 inch from bottom of door to top of decorative floor finish or covering.

3. 1/4 inch from bottom of door to top of threshold.

D. Repair, refinish, or replace factory-finished doors damaged during installation, as directed by Architect.

END OF SECTION 081416

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data, Shop Drawings, and color Samples.
   1. For entrance doors, include hardware schedule.

PART 2 - PRODUCTS

2.1 ALUMINUM-FRAMED STOREFRONTS

A. Manufacturers: Kawneer

B. Basis-of-Design Product: 350 Medium Stile Entry System (Medium Bronze) or a comparable product of one of the following:
   1. Arcadia, Inc.
   2. Arch Aluminum & Glass Co., Inc.
   3. CMI Architectural
   4. Commercial Architectural Products, Inc.
   5. EFCO Corporation.
   6. Leed Himmel Industries, Inc.
   7. Pittco Architectural Metals, Inc.
   8. TRACO.
   9. Tubelite.
   10. United States Aluminum.
   11. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
   12. YKK AP America Inc.

C. Accessible Entrances: Comply with ICC A117.1.

D. Performance Requirements:
   1. Limit deflection of framing members normal to wall plane to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
   2. Limit deflection of framing members parallel to glazing plane to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
   3. Structural Testing: Systems tested according to ASTM E 330 at 150 percent of inward and outward wind-load design pressures do not evidence material failures, structural distress, deflection failures, or permanent deformation of main framing members exceeding 0.2 percent of clear span.

4. Air Infiltration: Limited to 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of system surface area when tested according to ASTM E 283 at a static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa).
5. Water Penetration: Systems do not evidence water leakage when tested according to ASTM E 331 at minimum differential pressure of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
6. Thermal Conductance: Average U-factor of not more than 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) when tested according to AAMA 1503.
7. Windborne-Debris Resistance: Framing system and doors pass basic-protection testing requirements in ASTM E 1996 for Local Wind Zone when tested according to ASTM E 1886.

E. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated; ASTM B 209 (ASTM B 209M) sheet; ASTM B 221 (ASTM B 221M) extrusions.

F. Glazing: As specified in Section 088000 "Glazing."

G. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

H. Doors: 1-3/4-inch- (44.5-mm-) thick glazed doors with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods. Provide snap-on extruded-aluminum glazing stops, and preformed gaskets.
1. Door Design: Medium stile; 3-1/2-inch (88.9-mm) nominal width.
2. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.
3. Interior Doors: Provide BHMA A156.16 silencers, three on strike jamb of single-door frames and two on head of double-door frames.
4. Exterior Doors: Provide compression weather stripping at fixed stops. At other locations, provide sliding weather stripping retained in adjustable strip mortised into door edge.
5. Hardware: As specified in Section 087100 "Door Hardware."

I. Fasteners and Accessories: Compatible with adjacent materials, corrosion resistant, nonstaining, and nonbleeding. Use concealed fasteners except for application of door hardware.

J. Fabrication: Fabricate framing in profiles indicated for flush glazing (without projecting stops). Provide subframes and reinforcing of types indicated or, if not indicated, as required for a complete system. Factory assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.
1. Door Framing: Reinforce to support imposed loads. Factory assemble door and frame units and factory install hardware to greatest extent possible. Reinforce door and frame units for hardware indicated. Cut, drill, and tap for factory-installed hardware before finishing components.

K. Aluminum Finish: Dark Bronze

PART 3 - EXECUTION

3.1 INSTALLATION

A. Isolate metal surfaces in contact with incompatible materials, including wood, by painting contact surfaces with bituminous coating or primer, or by applying sealant or tape recommended by manufacturer.

B. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

D. Install framing components true in alignment with established lines and grades to the following tolerances:
   1. Variation from Plane: Limit to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
   2. Alignment: For surfaces abutting in line, limit offset to 1/16 inch (1.5 mm). For surfaces meeting at corners, limit offset to 1/32 inch (0.8 mm).
   3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

E. Install doors without warp or rack. Adjust doors and hardware to provide tight fit at contact points and smooth operation.

END OF SECTION 084113

SECTION 085200 - WOOD WINDOWS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data, Shop Drawings, and color Samples.

B. Quality Standard: Comply with AAMA/NWWDA 101/I.S.2/NAFS.

1. Provide AAMA- or WDMA-certified wood windows with an attached label.

PART 2 - PRODUCTS

2.1 WOOD WINDOWS

A. Available Products:

1. Weathershield, Marvin, Pella, Andersen or equivalent

B. Provide aluminum-clad wood windows.

C. Window Types: As indicated on Drawings.

1. Casement
2. Fixed transoms

D. Performance Class: C.

E. Performance Grade: 50.

F. Thermal Transmittance: Whole-window U-factor not more than 0.60 Btu/sq. ft. x h x deg F (3.4 W/sq. m x K) at 15-mph (24-km/h) wind velocity and winter temperatures per ASTM E 142

G. Trim: Provide indicated trim, matching material and finish of frame members.

H. Provide gear-type rotary operators with folding handles for casement windows.

I. Equip units with vinyl-coated, glass-fiber mesh insect screens on operable sashes.

J. Equip units with removable grilles as indicated, attach to inside face of each lite.

K. Exterior Color: White.

L. Glaze units with low-e coated, sealed insulating glass, complying with Division 08 Section "Glazing."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set units level, plumb, and true to line, without warp or rack of frames and panels. Provide proper support and anchor securely in place.

B. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.

C. Adjust operating panels, screens, and hardware to provide a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

D. Clean glass and aluminum surfaces immediately after installing windows. Remove nonpermanent labels from glass surfaces.

END OF SECTION 085200

SECTION 088000 - GLAZING

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 glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Windows.
   2. Doors.
   3. Storefront framing.
   4. Glazed entrances.
   5. Interior borrowed lights.

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lights of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:
   1. Design Wind Pressures: As indicated on Drawings.
   2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.

a. Wind Design Data: As indicated on Drawings.
b. Basic Wind Speed: 90 mph (40 m/s).
c. Importance Factor: 1.5
d. Exposure Category: B.

3. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
4. Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass to resist each of the following combinations of loads:
   a. Outward design wind pressure minus the weight of the glass. Base design on glass type factors for short-duration load.
   b. Inward design wind pressure plus the weight of the glass plus half of the design snow load. Base design on glass type factors for short-duration load.
   c. Half of the inward design wind pressure plus the weight of the glass plus the design snow load. Base design on glass type factors for long-duration load.
5. Glass Type Factors for Wired, Patterned, and Sandblasted Glass:
   a. Short-Duration Glass Type Factor for Wired Glass: 0.5.
   b. Long-Duration Glass Type Factor for Wired Glass: 0.3.
   c. Short-Duration Glass Type Factor for Patterned Glass: 1.0.
   d. Long-Duration Glass Type Factor for Patterned Glass: 0.6.
   e. Short-Duration Glass Type Factor for Sandblasted Glass: 0.5.
6. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
7. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
8. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
9. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lights.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
   1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
   2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.

3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.6 ACTION SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
1. Tinted glass.
2. Patterned glass.
3. Coated glass.
4. Wired glass.
5. Fire-resistive glazing products.
6. Laminated glass with colored interlayer.
7. Insulating glass.

C. Glazing Accessory Samples: For gaskets sealants and colored spacers, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installers manufacturers of insulating-glass units with sputter-coated, low-e coatings and sealant testing agency.

B. Product Certificates: For glass and glazing products, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for tinted glass, coated glass, insulating glass, glazing sealants, and glazing gaskets.
1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.

E. Warranties: Sample of special warranties.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

E. Source Limitations for Glass: Obtain ultraclear float glass, tinted float glass, coated float glass, laminated glass, and insulating glass from single source from single manufacturer for each glass type.

F. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
   2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

I. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F (250 deg C), and the fire-resistance rating in minutes.

J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

K. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

L. Pre-installation Conference: Conduct conference at Project site.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C).

1.11 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lights in thicknesses as needed to comply with requirements indicated.
   1. Minimum Glass Thickness for Exterior Lights: Not less than 6.0 mm.
   2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes enhanced-protection testing requirements in ASTM E 1996 for Wind Zone 4 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.
   1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
   2. Small-Missile Test: For glazing located more than 30 feet (9.1 m) above grade.
   3. Large-Missile Test: For all glazing, regardless of height above grade.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
   2. For laminated-glass lites, properties are based on products of construction indicated.
   3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
   4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
   5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
   6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
   1. Thickness: 1/4"
   2. Manufacturer: Provide the following, or equivalent:
   3. Guardian SunGuard; (866) 482-7374; www.SunGuardGlass.com
   4. Contact: Dale Hauser
   5. Telephone: (765) 404-0964

2.3 INSULATING GLASS

A. Manufacturers:

B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

C. Typical Exterior Windows
   1. Sealing / Glazing System: **1 OA ¼ SN 68 #2, ½ Mill (SIL), ¼ Clear**

D. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Glass Types" Article.

2.4 FIRE-PROTECTION-RATED GLAZING

A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies.

2.5 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
   1. Neoprene complying with ASTM C 864.
   2. EPDM complying with ASTM C 864.
   3. Silicone complying with ASTM C 1115.
   4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
   1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.6 GLAZING SEALANTS

A. General:
1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
4. Sealants used inside the weatherproofing system 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."
5. Colors of Exposed Glazing Sealants: As selected by Architect.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
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 Corning Corporation; 790/795.
   b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
   c. May National Associates, Inc.; Bondaflex Sil 290.
   d. Pecora Corporation; 890.
   e. Sika Corporation, Construction Products Division; SikaSil-C990.
   f. Tremco Incorporated; Spectrem 1.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.8 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Presence and functioning of weep systems.
   3. Minimum required face and edge clearances.
   4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.8 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 092400 - PORTLAND CEMENT PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior portland cement plasterwork on metal lath. Existing plaster to be skim coated where it is required.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Usually delete first paragraph below and show locations and details of control and expansion joints on Drawings.

C. Shop Drawings: Show locations and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other work.

D. Samples: For each type of factory-prepared finish coat indicated.

1.3 QUALITY ASSURANCE

A. Fire-Resistance Ratings: Where indicated, provide portland cement plaster assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Sound-Transmission Characteristics: Where indicated, provide portland cement plaster assemblies identical to those of assemblies tested for STC ratings per ASTM E 90 and classified according to ASTM E 413 by a qualified testing agency.

C. Mockups: Before plastering, install mockups of at least 100 sq. ft. (9.3 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 PROJECT CONDITIONS

A. Comply with ASTM C 926 requirements.

B. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

PART 2 - PRODUCTS

2.1 METAL LATH

A. Expanded-Metal Lath: ASTM C 847 with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
2. Diamond-Mesh Lath: Self-furring, 2.5 lb/sq. yd. (1.4 kg/sq. m).

2.2 ACCESSORIES

A. General: Comply with ASTM C 1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:
1. Cornerite: Fabricated from metal lath with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
2. External-Corner Reinforcement: Fabricated from metal lath with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
3. Cornerbeads: Fabricated from zinc-coated (galvanized) steel.

   a. Bull-nose style; use unless otherwise indicated.

4. Casing Beads: Fabricated from zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
5. Control Joints: Fabricated from zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
6. Expansion Joints: Fabricated from zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.

2.3 MISCELLANEOUS MATERIALS

A. Water for Mixing: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch (13 mm) long, free of contaminants, manufactured for use in portland cement plaster.

C. Bonding Compound: ASTM C 932.

D. Steel Drill Screws: For metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with pan head that is suitable for application; in lengths required to achieve penetration through joined materials of no fewer than three exposed threads.

E. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 1063.

F. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter, unless otherwise indicated.

2.4 PLASTER MATERIALS

A. Portland Cement: ASTM C 150, Type I.

1. Color for Finish Coats: White.

B. Masonry Cement: ASTM C 91, Type N.

1. Color for Finish Coats: White.

C. Plastic Cement: ASTM C 1328.

D. Colorants for Job-Mixed Finish Coats: Colorfast mineral pigments that produce finish plaster color: to be selected.

E. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.

F. Sand Aggregate: ASTM C 897.

1. Color for Job-Mixed Finish Coats: White.

G. Perlite Aggregate: ASTM C 35.

H. Ready-Mixed Finish-Coat Plaster: Mill-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.

1. Color: As selected by Architect from manufacturer's full range.

I. Acrylic-Based Finish Coatings: Factory-mixed acrylic-emulsion coating systems, formulated with colorfast mineral pigments and fine aggregates; for use over portland cement plaster base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic-based finishes.

1. Color: As selected by Architect from manufacturer's full range.

2.5 PLASTER MIXES

A. General: Comply with ASTM C 926 for applications indicated.

1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. (0.6 kg of fiber/cu. m) of cementitious materials.

B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:

1. Portland Cement Mixes:

   a. Scratch Coat: For cementitious material, mix 1 part portland cement and 0 to ¾ parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
   b. Brown Coat: For cementitious material, mix 1 part portland cement and 0 to ¾ parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

2. Masonry Cement Mixes:

   a. Scratch Coat: 1 part masonry cement and 2-1/2 to 4 parts aggregate.
   b. Brown Coat: 1 part masonry cement and 3 to 5 parts aggregate, but not less than volume of aggregate used in scratch coat.

3. Portland and Masonry Cement Mixes:

   a. Scratch Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
   b. Brown Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

4. Plastic Cement Mixes:

   a. Scratch Coat: 1 part plastic cement and 2-1/2 to 4 parts aggregate.
   b. Brown Coat: 1 part plastic cement and 3 to 5 parts aggregate, but not less than volume of aggregate used in scratch coat.

5. Portland and Plastic Cement Mixes:

   a. Scratch Coat: For cementitious material, mix 1 part plastic cement and 1 part portland cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
   b. Brown Coat: For cementitious material, mix 1 part plastic cement and 1 part portland cement. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

C. Base-Coat Mixes: Single base coats for two-coat plasterwork as follows:

1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 0 to 3/4 part lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
2. Portland and Masonry Cement Mix: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
3. Plastic Cement Mix: Use 1 part plastic cement and 2-1/2 to 4 parts aggregate.

D. Base-Coat Mixes: Single base coats for two-coat plasterwork as follows:

1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
2. Masonry Cement Mix: Use 1 part masonry cement and 2-1/2 to 4 parts aggregate.
3. Plastic Cement Mix: Use 1 part plastic cement and 2-1/2 to 4 parts aggregate.

E. Job-Mixed Finish-Coat Mixes:

1. Portland Cement Mix: For cementitious materials, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
2. Masonry Cement Mix: 1 part masonry cement and 1-1/2 to 3 parts aggregate.
3. Portland and Masonry Cement Mix: For cementitious materials, mix 1 part portland cement and 1 part masonry cement. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
4. Plastic Cement Mix: 1 part plastic cement and 1-1/2 to 3 parts aggregate.

F. Factory-Prepared Finish-Coat Mixes: For acrylic-based finish coatings, comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

B. Prepare solid substrates for plaster that are smooth or that do not have the suction capability required to bond with plaster according to ASTM C 926.

3.2 INSTALLATION, GENERAL

A. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.

B. Sound Attenuation Blankets: Where required, install blankets before installing lath unless blankets are readily installed after lath has been installed on one side.

C. Acoustical Sealant: Where required, seal joints between edges of plasterwork and abutting construction with acoustical sealant.

3.3 INSTALLING METAL LATH

A. Expanded-Metal Lath: Install according to ASTM C 1063.

1. Partition Framing and Vertical Furring: Install flat diamond-mesh lath.
2. Flat-Ceiling and Horizontal Framing: Install flat diamond-mesh lath.
3. Curved-Ceiling Framing: Install flat diamond-mesh lath.
4. On Solid Surfaces, Not Otherwise Furred: Install self-furring, diamond-mesh lath.

3.4 INSTALLING ACCESSORIES

A. Install according to ASTM C 1063 and at locations indicated on Drawings.

B. Reinforcement for External Corners:

1. Install lath-type, external-corner reinforcement at exterior locations.
2. Install cornerbead at interior locations.

C. Control Joints: Install control joints in specific locations approved by Architect for visual effect as follows:

1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:

a. Vertical Surfaces: 144 sq. ft. (13.4 sq. m).
b. Horizontal and other Nonvertical Surfaces: 100 sq. ft. (9.3 sq. m).

2. At distances between control joints of not greater than 18 feet (5.5 m) o.c.
3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
4. Where control joints occur in surface of construction directly behind plaster.
5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.5 PLASTER APPLICATION

A. General: Comply with ASTM C 926.

B. Bonding Compound: Apply on unit masonry and concrete plaster bases.

C. Walls; Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork, on masonry , on concrete; 3/4-inch (19-mm) thickness.

1. Portland cement mixes.

2. Masonry cement mixes.
3. Portland and masonry cement mixes.
4. Plastic cement mixes.
5. Portland and plastic cement mixes.

D. Ceilings; Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork; 1/2 inch (13 mm) thick.

1. Portland cement mixes.
2. Masonry cement mixes.
3. Portland and masonry cement mixes.
4. Plastic cement mixes.
5. Portland and plastic cement mixes.

E. Walls; Base-Coat Mix: Scratch coat for two-coat plasterwork, 3/8 inch (10 mm) thick on concrete masonry.

1. Portland cement mixes.
2. Masonry cement mixes.
3. Portland and masonry cement mixes.
4. Plastic cement mixes.
5. Portland and plastic cement mixes.

F. Ceilings; Base-Coat Mix: Scratch coat for two-coat plasterwork, 1/4 inch (6 mm) thick on concrete.

1. Portland cement mixes.
2. Masonry cement mixes.
3. Portland and masonry cement mixes.
4. Plastic cement mixes.
5. Portland and plastic cement mixes.

G. Plaster Finish Coats: Apply to provide finish to match existing.

H. Acrylic-Based Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.

I. Concealed Exterior Plasterwork: Where plaster application will be used as a base for adhered finishes, omit finish coat.

J. Concealed Interior Plasterwork:

1. Where plaster application will be concealed behind built-in cabinets, similar furnishings, and equipment, apply finish coat.
2. Where plaster application will be concealed above suspended ceilings and in similar locations, finish coat may be omitted.
3. Where plaster application will be used as a base for adhesive application of tile and similar finishes, omit finish coat.

3.6 PLASTER REPAIRS

A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

END OF SECTION 092400

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

B. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 METAL FRAMING AND SUPPORTS

A. Steel Framing Members, General: ASTM C 754.

1. Steel Sheet Components: ASTM C 645, with manufacturer's standard corrosion-resistant zinc coating.

B. Elevator Furring:

1. Furring Channels: Steel, rigid hat-shaped channels; 7/8 inch (22.2 mm) deep, 0.0179 inch (0.45 mm) thick.

2.2 PANEL PRODUCTS

A. Provide in maximum lengths available to minimize end-to-end butt joints.

B. Gypsum Wallboard: ASTM C 36, in thickness indicated, with manufacturer's standard edges. Type X throughout. High-impact in corridors.

C. Water-Resistant Gypsum Backing Board: ASTM C 630, in thickness indicated. Regular type, unless otherwise indicated. Type X where required for fire-resistance-rated assemblies and where indicated. Locate in Rest Rooms and at all damp locations.

2.3 ACCESSORIES

1. Provide cornerbead at outside corners, unless otherwise indicated.
2. Provide LC-bead (J-bead) at exposed panel edges.
3. Provide control joints where indicated.

B. Joint-Treatment Materials: ASTM C 475.

1. Joint Tape: Paper, unless otherwise recommended by panel manufacturer.
2. Joint Compounds: Drying-type, ready-mixed, all-purpose compounds.

C. Miscellaneous Materials: Auxiliary materials for gypsum board construction that comply with referenced standards.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install steel framing to comply with ASTM C 754 and with ASTM C 840 requirements that apply to framing installation and with United States Gypsum's "Gypsum Construction Handbook."

B. Isolate steel framing from building structure, except at floor, to prevent transfer of loading imposed by structural movement.

C. Install and finish gypsum panels to comply with ASTM C 840 and GA-216.

1. Isolate gypsum board assemblies from abutting structural and masonry work. Provide edge trim and acoustical sealant.
2. Single-Layer Fastening Methods: Fasten gypsum panels to supports with screws.
3. Install and seal joints per Georgia Pacific's Method #1 for all Dens-Glass products.

D. Fire-Resistance-Rated Assemblies: Comply with requirements of listed assemblies.

E. Finishing Gypsum Board Assemblies:

1. Unless otherwise indicated, provide Level 4 finish: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges.
2. At concealed areas, unless a higher level of finish is required for fire-resistance-rated assemblies, provide Level 1 finish: Embed tape at joints.
3. At substrates for tile, provide Level 2 finish: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges.

END OF SECTION 09260

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and Samples.

B. Obtain tile of each type and color or finish from same production run for each contiguous area

C. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling ceramic tile packages.

PART 2 - PRODUCTS

2.1 CERAMIC TILE

A. Ceramic tile that complies with Standard grade requirements in ANSI A137.1, "Specifications for Ceramic Tile."

B. Tile Type 1: Factory-mounted unglazed, porcelain cushion-edged ceramic mosaic tile.

1. Manufacturers: One of the following:
2. Basis-of-Design Product: Product indicated on Drawings a comparable product of one of the following:
   a. Crossville, Inc. Notorious

3. Module Size: 12 by 24 inch
4. Surface: Slip resistant, with abrasive admixture.
5. Finish: Mat, clear glaze.
6. Color and Pattern: As selected
7. Grout Color: As selected
8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile and matching characteristics of adjoining flat tile:

   a. Base: Coved.
   b. Base Cap for Thin-Set Mortar Installations: Surface bullnose.
   c. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose.
   d. External Corners for Thin-Set Mortar Installations: Surface bullnose.
   e. Internal Corners: Cove.

2.2 INSTALLATION MATERIALS

A. Waterproofing Membranes for Thin-Set Installations: ANSI A118.10, urethane waterproofing and adhesive.

B. Setting and Grouting Materials: Comply with material standards in ANSI's "Specifications for the Installation of Ceramic Tile" that apply to materials and methods indicated.

1. Thin-Set Mortar Type: Dry-set Portland cement.

a. Manufacturers: One of the following:
b. Basis-of-Design Product: or a comparable product of one of the following:
1) Bostik, Inc.
2) MAPEI Corporation.
3) TEC; a subsidiary of H. B. Fuller Company.

2. Grout Type: Standard cement, unless otherwise indicated.

a. Manufacturers: One of the following:
b. Basis-of-Design Product: or a comparable product of one of the following:
1) Bostik, Inc.
2) MAPEI Corporation.
3) TEC; a subsidiary of H. B. Fuller Company.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For installations indicated below, follow procedures in ANSI's "Specifications for the Installation of Ceramic Tile" for providing 95 percent mortar coverage.

a. Tile floors in wet areas.
b. Tile floors composed of tiles 8 by 8 inches or larger.
c. Tile floors composed of rib-backed tiles.

B. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

C. Lay tile in grid pattern unless otherwise indicated. Align joints where adjoining tiles on floor, base, walls, and trim are the same size.

D. Install cementitious backer units and treat joints according to ANSI A108.11.

E. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

F. Install waterproofing to comply with ANSI A108.13.

G. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

H. Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thin set).

I. Apply sealer to cleaned stone tile flooring according to sealer manufacturer's written instructions.

J. Interior Floor Tile Installation Method(s):

1. Over Concrete Subfloors: TCA F113 (thin-set mortar)

K. Interior Wall Tile Installation Method(s):
1. Over Metal Studs or Furring: TCA W243 (thin-set mortar on gypsum board)

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acoustical panels for ceilings.

1.2 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Evaluation reports.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to NVLAP.

B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockup of typical ceiling area as shown on Drawings.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
   2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANEL CEILINGS, GENERAL

A. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.

B. Acoustical Panel Standard: Comply with ASTM E 1264.

C. Metal Suspension System Standard: Comply with ASTM C 635.

D. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

2.3 ACOUSTICAL PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
   1. Armstrong World Industries, Inc.

C. Classification: Ultima High NRC; 2'x2’x1”.

D. Color: White.

E. LR: 0.83.

F. NRC: .050

G. CAC: 35.

H. Edge/Joint Detail: 15/16" Prelude Grid.

I. Thickness: 7/8 inch.

J. Modular Size: 24 by 24 inches.

K. Grid: Prelude 15/16" Grid.

2.4 METAL SUSPENSION SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide the following: or comparable product by one of the following:
   1. Armstrong World Industries, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.
   1. Arrange directionally patterned acoustical panels as indicated on reflected ceiling plans.

END OF SECTION 095113

SECTION 096510 – DECORATIVE EPOXY FLOOR SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Section Includes

1. Special decorative epoxy flooring system materials including underlayments, waterproofing membranes, primers, fillers, and other applied materials used as prime, body coat and finish coats and the application of these materials.

B. Provisions established within the Contract, Division 1, General Requirements, and the Drawings are collectively applicable to this Section.

1.2 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

B. Military Specification (MIL)
MIL-D-24613 Deck Covering Materials, Interior Cosmetic Polymeric

1.3 SUBMITTALS

A. Prior to commencing work, submit manufacturer's technical information and installation details to describe materials to be used. The same manufacturer shall supply all polymer wall and floor finishes.

B. Owner and Contractor shall review and mutually agree upon color, grade and final texture of special decorative floor system before starting installation.

C. Before beginning work, samples of the type of flooring shall be provided for the owners/architect's approval.

1.4 QUALITY ASSURANCE

A. Contractor shall be an established firm regularly engaged in satisfactory installation of similar materials and provide a list of 3 projects of similar nature and complexity completed in the last 5 years. Contractor shall provide a letter of certification by manufacturer that Contractor is a current qualified installer.

B. Single source responsibility: Provide fillers, underlayments, waterproof membrane, primers, body coats and top coats produced by the same manufacturer with no less than 10 years of experience in the manufacture and supply of princi-

pal materials for work in this section.

C. Prior to commencing the installation, the Contractor shall install, with Owner's approval, a mutually agreed upon sample ("mock-up") to show final color and texture of the system. This mock-up shall serve as a job standard for the final installation.

1.5 DELIVERY AND STORAGE

A. Material shall be delivered to project site in manufacturer's original unopened containers bearing manufacturer's name, product and color.

B. Materials shall be stored indoors, protected from damage, moisture, direct sunlight and temperatures below 50 degrees F or above 80 degrees F.

1.6 WARRANTY

A. Contractor shall furnish a written warranty covering both material and workmanship for a period of one full year from the date of installation.

PART 2 - PRODUCTS

2.1 Manufacturer: BASF

A. Product: MasterTop 1234

1. Special decorative flooring shall be a two-component epoxy floor system with colored quartz aggregate applied to a minimum finished thickness of 1/8 inch. Decorative special flooring shall be finished with a minimum of two clear topcoats to achieve the texture selected.

a. Physical Properties - The Special Decorative Flooring Systems shall comply with the following minimum test standards

Compressive Strength, ASTM C 579	12,300 psi
Tensile Strength, ASTM D 638	1,160 psi
Flexural Strength, ASTM D 790	4,600 psi
Indentation, MIL-D-24613	24 hrs. residual, 0.0008 inch
Impact Resistance, MIL-D-24613	No chipping, cracking or delamination
Fire Resistance, MIL-D-24613	Fire retardant
Nonslip properties, MIL-D-24613	Static Friction .6
	Static Friction .6
Abrasion Resistance, CS17 Wheel 1000 gram load, 1000 cycles	.060 gram loss

A. MasterTop TC 493 Chemical Resistance Polyurethane Top Coat

1. Chemical resistant aliphatic polyurethane sealer applied by squeegee or trowel and roller at a minimum dry film thickness of 4 mils.

a. Physical Properties - The chemical resistant sealer shall comply with the following minimum test standards:

Composition	*Aliphatic Polyurethane*
Taber Abrasion, ASTM D 4060, CS 17 wheels @ 1,000 cycles, 1,000 gram load	*75 mg loss*
Impact Resistance 160 IN-LBS, Gardner Impact Test	*PASS*
Slip resistance (Coefficient of Friction) ASTM D-2047	*0.74 dry* *0.73 wet*
Mixed VOC	*335g/L, 39 % solids*
Mixed Viscosity	*350-450 cps*
Pot Life	*1.5 hours +/- 15 minutes*
Recoat Interval	*3 – 4 hours*

b. Chemical Resistance. The flooring system shall show no chemical attack or discoloration when tested in accordance with ASTM D 1308 at 72 degrees F. against the following reagents and concentrations noted for 7 days.

c.

Reagent	*Reagent*
Acetic Acid 20%	*Benzene*
Acetone	*Benzoic Acid*
Hydrofluoric Acid	*Butyl Alcohol*
Lactic Acid 50%	*Citric Acid*
Nitric Acid 10%	*Diesel Fuel*
Phenol	*Stearic Acid*
Sulfuric Acid 45%	*Amyl Acetate*
Toluene	*Dichloracetic Acid*
Trichloroethylene	*Chlorobenzene*

B. Supplier: CSS Coatings; 3362 Industrial Dr.
Bowling Green, KY 42101
Phone (270) 793-9069
Fax (270) 793-9082
Contact: Matt Nelson

C. Installer: CSS Coatings, or equal

D. Color: Selected by Owner (3 colors)

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. After concrete curing period (28 days minimum) has elapsed, surface must be clean and dry, physically sound and free of contamination. Surfaces must be free
of holes, voids, or defects. Cracks and abrupt changes in surface profile must be corrected. Fins and projections must be removed. All curing compounds and sealers must be removed.

B. Verify that moisture content is within range acceptable to flooring manufacturer, using a calcium chloride test kit in accordance with ASTM F-1869.

C. Contractor must report, in writing, surfaces left in improper condition by other trades. Application will constitute acceptance of surfaces by the applicator.

3.2 PREPARATION

A. Prepare surfaces as required, per manufacturer's printed instructions. Preferred surface preparation is shotblast or similar mechanical method.

B. Patch all depressions, divots, honeycombed or scaled concrete with filler as recommended by manufacturer.

C. Level and slope floor, as required, with manufacturer's acrylic or epoxy modified mortar underlayment.

D. Fill all non-moving cracks or control joints with joint filler as recommended by manufacturer.

E. Fill all moving cracks or joints with a firm but flexible (or non-rigid) sealant material as recommended by manufacturer. Expansion joints should be re-cut in finished floor, if required, and filled with sealant.

F. Masking: Mask surfaces that require protection.

3.3 INSTALLATION

A. Comply with flooring system manufacturer's recommendation.

1. Materials shall be prepared and mixed in compliance with flooring manufacturer's instructions.

3. Apply primer/receiving coat of epoxy resin.

4. Broadcast selected pattern of colored quartz aggregate into wet epoxy to complete saturation, dry appearance. Allow to cure overnight.

5. Vacuum excess aggregate. Apply second broadcast application to achieve necessary thickness of 1/8 inch.

6. After overnight cure, vacuum excess aggregate and apply clear polyurethane grout coat.

7. Apply clear polyurethane finish to achieve desired finish and texture selected.

B. Cove Base: Where specified, install a 4-inch-high with a nominal 1-inch radius onto wall surfaces. All cove bases shall terminate into cap strips, unless otherwise noted on drawings.

3.4 CLEANUP

A. Remove waste materials, rubbish and debris and dispose of them at Owner's direction. Leave work areas in a clean condition.

3.5 PROTECTION

A. Protect the completed work from water, airborne particles or other surface contaminants until cured, tack free, approximately 18-24 hours after application.

B. Protect completed system from traffic and physical abuse for approximately 72 hours. Protect completed system from immersion and chemical exposure until thoroughly cured, approximately seven (7) days at 70° F.

B. Protection from migrating plasticizers from tires that may discolor the floor rubber mats made specifically for this purpose should be utilized as protection under the tires

END OF SECTION 096510

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Resilient base.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: 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.

1.4 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive resilient products.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: (Verify with specifications on ID sheets that alternate manufacturers have comparable product as listed on the finish schedule)
      a. Armstrong World Industries, Inc.
      b. Flexco, Inc.
      c. Johnsonite.
      d. Roppe Corporation, USA.

B. Resilient Base Standard: ASTM F 1861.

C. Lengths: Coils in manufacturer's standard length.

D. Outside Corners: Job formed or preformed.

E. Inside Corners: Job formed or preformed.

F. Finish: As selected by Architect from manufacturer's full range.

G. Colors and Patterns: To be selected.

H. Height: 4”

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
   1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
      a. Cove Base Adhesives: Not more than 50 g/L.
      b. Rubber Floor Adhesives: Not more than 60 g/L.

C. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.

D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

E. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Treads and Accessories: 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 manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are same temperature as the space where they are to be installed.
1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

3.3 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Rubber Stair tread and risers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: Full-size units of each color and pattern of floor tile required.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: 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.

1.5 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive floor tile.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

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. Floor Score Compliance: Resilient tile flooring shall comply with requirements of Floor Score Standard.

2.2 RUBBER STAIR TREADS AND RISERS

A. Products: Subject to compliance with requirements, provide the following
   1. Johnsonite.; Solid Rubber, Cubis Design

B. Tread Standard/ Riser Standard: ASTM F 2169, Type TS, Class 1 and 2, Group 1 and 2; ASTM F 1861, Type TP, Group 1

C. Wearing Surface: Cubis SurfaceTextured With integrated riser

D. Thickness: 0.125 inch

E. Size: 2” hinged, Square nose configuration, tapered 13” tread depth with 7” integral riser.

F. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

C. Floor Score Compliance: Resilient tile flooring shall comply with requirements of Floor Score Standard.

   1. Adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

      a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.
      b. Rubber Floor Adhesives: Not more than 60 g/L.

D. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

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 manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by floor covering manufacturer. Proceed with installation only after substrates pass testing.

a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are same temperature as space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 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 square with room axis

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles in pattern of colors and sizes indicated.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

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.

3.3 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

B. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 09 65 19.23 – Luxury Vinyl Tile Flooring

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Flooring and accessories as shown on the drawings and schedules and as indicated by the requirements of this section.
B. Related Documents
   1. Drawings and General Provisions of the Contract (including General and Supplementary Conditions and Division 1 sections) apply to the work of this section.
C. Related Sections:
   1. Other Division 9 sections for floor finishes related to this section but not the work of this section
   2. Division 3 Concrete; not the work of this section
   3. Division 6 Wood and Plastics; not the work of this section
   4. Division 7 Thermal and Moisture Protection; not the work of this section

1.02 REFERENCES

A. Armstrong Flooring Technical Manuals
   1. Armstrong Flooring Guaranteed Installation Systems manual, F-5061
   2. Armstrong Flooring Maintenance Recommendations and Procedures, manual, F-8663.
B. ASTM International:
   1. ASTM E 648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
   2. ASTM E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
   3. ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
   4. ASTM F 1482, Standard Guide to Wood Underlayment Products Available for Use Under Resilient Flooring
   5. ASTM F 1700 Standard Specification for Solid Vinyl Tile
   6. ASTM F 1861 Standard Specification for Resilient Wall Base
   7. ASTM F 1869 Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
   8. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
C. National Fire Protection Association (NFPA):
   1. NFPA 253 Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
   2. NFPA 258 Standard Test Method for Measuring the Smoke Generated by Solid Materials
D. Standards Council of Canada
   1. CAN/ULC-S102.2 Standard Test Method for Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies

1.03 SYSTEM DESCRIPTION

A. Performance Requirements: Provide flooring which has been manufactured, fabricated and installed to performance criteria certified by manufacturer without defects, damage, or failure.

B. Administrative Requirements
   1. Pre-installation Meeting: Conduct an on-site pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.
   2. Pre-installation Testing: Conduct pre-installation testing as follows: [Specify testing (i.e. moisture tests, bond test, pH test, etc).]
C. Sequencing and Scheduling
   1. Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring.
   2. Do not install flooring over concrete slabs until they are sufficiently dry to achieve a bond with the adhesive, in accordance with the manufacturer's recommended bond, moisture tests and pH test.

1.04 SUBMITTALS

A. Submit shop drawings, seaming plan, coving details, and manufacturer's technical data, installation and maintenance instructions (latest edition of Armstrong Flooring Guaranteed Installation Systems manual, F-5061. for flooring and accessories.

B. Submit the manufacturer's standard samples showing the required colors for flooring and applicable accessories.

C. Submit Safety Data Sheets (SDS) available for adhesives, moisture mitigation systems, primers, patching/leveling compounds, floor finishes (polishes) and cleaning agents and Material Information Sheets for flooring products.

D. If required, submit the manufacturer's certification that the flooring has been tested by an independent laboratory and complies with the required fire tests.

E. Closeout Submittals: Submit the following:

   1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.

   2. Warranty: Warranty documents specified herein

1.05 QUALITY ASSURANCE

A. Single-Source Responsibility: provide types of flooring and accessories supplied by one manufacturer, including moisture mitigation systems, primers, leveling and patching compounds, and adhesives.

B. Select an installer who is experienced and competent in the installation of Armstrong resilient solid vinyl tile flooring and the use of Armstrong Flooring subfloor preparation products.

   1. Engage installers certified as Armstrong Commercial Flooring Certified Installers

   2. Confirm installer's certification by requesting their credentials

C. Fire Performance Characteristics: Provide resilient tile flooring with the following fire performance characteristics as determined by testing material in accordance with ASTM test methods indicated below by a certified testing laboratory or other testing agency acceptable to authorities having jurisdiction:

   1. ASTM E 648 (NFPA 253) Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I

2. ASTM E 662 (NFPA 258) (Smoke Generation) Maximum Specific Optical Density of 450 or less

1.06 DELIVERY, STORAGE AND HANDLING

A. Comply with Division 1 Product Requirements Sections

B. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

C. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.

D. Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

1.07 PROJECT CONDITIONS

A. Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65ºF (18ºC) and a maximum temperature of [100ºF (38ºC)][85ºF (29ºC)] for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature of 55ºF (13ºC) in areas where work is completed. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances. Refer to the Armstrong Flooring Guaranteed Installations Systems manual, F-5061 for a complete guide on project conditions.

1.08 LIMITED WARRANTY

A. Resilient Flooring: Submit a written warranty executed by the manufacturer, agreeing to repair or replace resilient flooring that fails within the warranty period.

B. Limited Warranty Period: 20 years for Natural Creations with Diamond 10 Technology.

C. The Limited Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

D. For the Limited Warranty to be valid, this product is required to be installed using the appropriate Armstrong Flooring Guaranteed Installation System. Product installed not using the specific instructions from the Guaranteed Installation System will void the warranty.

1.10 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials from same production run as products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Quantity: Furnish quantity of flooring units equal to 5% of amount installed.
2. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra material.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Resilient tile flooring, wall base, adhesives and subfloor preparation products and accessories:

1. Armstrong Flooring Inc., 2500 Columbia Avenue, Lancaster, PA 17604, www.armstrongflooring.com/commercial
2. Manufacturer must have a headquarters in the United States of America

2.02 RESILIENT TILE FLOORING MATERIALS

A. Provide Natural Creations® with Diamond 10® Technology: EarthCuts Luxury Solid Vinyl Tile Flooring manufactured by Armstrong Flooring Inc.

1. Description: A layered construction consisting of a tough, clear, rigid vinyl wear layer protecting a high-fidelity print layer on a solid vinyl backing. Protected by a diamond-infused UV-cured polyurethane finish, the wear surface is embossed with different textures to enhance each of the printed visuals. Colors are insoluble in water and resistant to cleaning agents and light.
2. Reference specification - ASTM F 1700, “Standard Specification for Solid Vinyl Tile", Class III, Type B – Embossed Surface. Meets requirements for size, squareness, thickness, thickness of wear layer, residual indentation, resistance to chemicals, resistance to light and resistance to heat.
3. Pattern and Color: in [%COLOR%] [color selected from the range currently available from Armstrong Flooring Inc.]
4. Size: 12 in. x 24 in.
5. Wear layer thickness: 0.020 (0.5 mm)
6. Thickness: 1/8"/0.125 in. (3.2mm)

2.03 PRODUCT SUBSTITUTION

A. Substitutions: No substitutions permitted because of the specific attributes listed in Section 2.02.

2.05 ADHESIVES

A. Provide Armstrong S-288 Flooring Adhesive under the flooring and Armstrong S-725 Wall Base Adhesive at the wall base as recommended by the flooring manufacturer.

B. [Provide Armstrong S-310 Roll Strong™ Adhesive for field areas and S-725 Wall Base Adhesive at the wall base as recommended by the flooring manufacturer].

C. [Provide Armstrong S-240 Epoxy Adhesive] under the flooring and Armstrong S-725 Wall Base Adhesive at the wall base as recommended by the flooring manufacturer].

2.06 ACCESSORIES

A. For patching, smoothing, and leveling monolithic subfloors (concrete, terrazzo, quarry tile, ceramic tile, and certain metals), provide Armstrong [S-184 Fast-Setting Cement-Based Patch and Underlayment] [S-194 Cement-Based Patch, Underlayment and Embossing Leveler / S-195 Underlayment Additive] [S-453 Level Strong™ cement based self-leveling compound] [S-456 Patch Strong™ flexible patching and smoothing compound].

B. [For priming porous substrates to aid in adhesive bond strength and reducing subfloor porosity, provide S-454 Prime Strong™ acrylic primer for porous substrates. For non-porous substrates, provide S-455 Prime Strong™ acrylic primer for non-porous substrates].

C. [For creating a moisture barrier, provide S-452 Seal Strong™ two part moisture mitigation system].

D. For sealing joints between the top of wall base or integral cove cap and irregular wall surfaces such as masonry, provide plastic filler applied according to the manufacturer's recommendations.

E. Provide transition/reducing strips tapered to meet abutting materials.

F. Provide threshold of thickness and width as shown on the drawings.

G. Provide resilient edge strips of width shown on the drawings, of equal gauge to the flooring, homogeneous vinyl or rubber composition, tapered or bullnose edge, with color to match or contrast with the flooring, or as selected by the Architect from standard colors available.

H. Provide metal edge strips of width shown on the drawings and of required thickness to protect exposed edges of the flooring. Provide units of maximum available length to minimize the number of joints. Use butt-type metal edge strips for concealed anchorage, or overlap-type metal edge strips for exposed anchorage. Unless otherwise shown, provide strips made of extruded aluminum with a mill finish.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including technical bulletins, product catalog, installation instructions, and product carton instructions for installation and maintenance procedures as needed.

3.02 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions (i.e. moisture tests, bond test, pH test, etc.).
B. Visually inspect flooring materials, adhesives and accessories prior to installation. Flooring material with visual defects shall not be installed and shall not be considered as a legitimate claim.
C. Examine subfloors prior to installation to determine that surfaces are smooth and free from cracks, holes, ridges, and other defects that might prevent adhesive bond or impair durability or appearance of the flooring material.
D. Inspect subfloors prior to installation to determine that surfaces are free from curing, sealing, parting and hardening compounds; residual adhesives; adhesive removers; and other foreign materials that might prevent adhesive bond. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.
E. Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
F. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the subfloor. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.

3.03 PREPARATION

A. [Subfloor Preparation: Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, and other defects with Armstrong Flooring [S-184 Fast-Setting Cement-Based Patch and Underlayment][S-194 Cement-Based Patch, Underlayment and Embossing Leveler / S-195 Underlayment Additive] [S-453 Level Strong™ cement based self-leveling compound] [S-456 Patch Strong™ flexible patching and smoothing compound] [S-454 Prime Strong™ acrylic primer for porous substrates] [S-455 Prime Strong™ acrylic primer for non-porous substrates] as recommended by the flooring manufacturer. Refer to Armstrong Flooring Guaranteed Installation Systems manual, F-5061 and ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring for additional information on subfloor preparation.]

B. [Subfloor Preparation Moisture Mitigation: Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, mitigate moisture and other defects with Armstrong Flooring [S-184 Fast-Setting Cement-Based Patch and Underlayment][S-194 Cement-Based Patch, Underlayment and Embossing Leveler / S-195 Underlayment Additive] [S-453 Level Strong™ cement based self-leveling compound] [S-456 Patch Strong™ flexible patching and smoothing compound] [S-452 Seal Strong™ two part moisture mitigation system] [S-454 Prime Strong™ acrylic primer for porous substrates] [S-455 Prime Strong™ acrylic primer for non-porous substrates] as recommended by the flooring manufacturer. Refer to Armstrong Flooring Guaranteed Installation Systems manual, F-5061 and ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring for additional information on subfloor preparation.]

C. Subfloor Cleaning: The surface shall be free of dust, solvents, varnish, paint, wax, oil, grease, sealers, release agents, curing compounds, residual adhesive, adhesive removers and other foreign materials that might affect the adhesion of resilient flooring to the concrete or cause a discoloration of the flooring from below. Remove residual adhesives as recommended by the flooring manufacturer. Remove curing and hardening compounds not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring. Avoid organic solvents. Spray paints, permanent markers and other indelible ink markers must not be used to write on the back of the flooring material or used to mark the concrete slab as they could bleed through, telegraphing up to the surface and permanently staining the flooring material. If these contaminants are present on the substrate they must be mechanically removed prior to the installation of the flooring material. Refer to the Armstrong Flooring Guaranteed Installation Systems manual, F-5061 and ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring for additional information on subfloor preparation.

D. When using S-288 Adhesive, perform subfloor moisture testing in accordance with [ASTM F 2170, “Standard Test Method for Determining Relative Humidity in Concrete Slabs Using *in-situ* Probes”] [ASTM F 1869,“Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride”] and Bond Tests as described in publication F-5061, "Armstrong Flooring Guaranteed Installation System," to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. [Internal relative humidity of the concrete shall not exceed 99%.][MVER shall not exceed 8 lbs./1000 sq. ft./24 hrs.] On installations where both the Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained

E. [When using Armstrong Roll Strong™ Adhesive, perform subfloor moisture testing in accordance with ASTM F 2170, “Standard Test Method for Determining Relative Humidity in Concrete Slabs Using *in-situ* Probes” and Bond Tests as described in publication F-5061, "Armstrong Flooring Guaranteed Installation System," manual to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to

receive flooring. Internal relative humidity of the concrete shall not exceed 90%. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained].

F. [When using S-240 Epoxy Adhesive, perform subfloor moisture testing in accordance with [ASTM F 2170, “Standard Test Method for Determining Relative Humidity in Concrete Slabs Using *in-situ* Probes”] [ASTM F 1869,“Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride”] and Bond Tests as described in publication F-5061, "Armstrong Flooring Guaranteed Installation System," to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. [Internal relative humidity of the concrete shall not exceed 90%.][MVER shall not exceed 8 lbs./1000 sq. ft./24 hrs.] On installations where both the Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained].

G. Concrete pH Testing: Perform pH tests on concrete floors regardless of their age or grade level. All test results shall be documented and retained.

H. Wood subfloors: Armstrong resilient floors are recommended on suspended wood subfloors with a 1/4" underlayment (see product installation systems for exceptions) and a minimum of 18" of well-ventilated air space below. Armstrong Flooring does not recommend installing resilient flooring on wood subfloors applied directly over concrete or on sleeper-construction subfloors. Loading requirements for subfloors are normally set by various building codes on both local and national levels. Trade associations such as APA–The Engineered Wood Association provide structural guidelines for meeting various code requirements. Subfloor panels are commonly marked with span ratings showing the maximum center-to-center spacing in inches of supports over which the panels should be placed.

    1. Refer to the Armstrong Flooring Guaranteed Installation Systems manual, F-5061 and ASTM F 1482, Standard Guide to Wood Underlayment Products Available for Use under Resilient Flooring for additional information.

I. Wood subfloors - Surface Cleaning: Make subfloor free from dust, dirt, grease, and all foreign materials.

    1. Check panels for sources of discoloration such as contamination from paint, varnish, stain overspray or spills, plumbing sealers, asphalt, heater fuel, markers or potential staining agents such as wood or bark not visible on the surface, edge sealers, logo markings, printed nail patterns and synthetic patches.

    2. Remove old adhesive.

    3. Cover adhesive, oil or wax residue with an appropriate underlayment. If the residue is tacky, place a layer of felt or polyethylene sheeting over it to prevent a cracking sound when walking on the floor.

    4. Remove all paint, varnish, oil and wax from all subfloors. Many buildings constructed before 1978 contain lead-based paint, which can pose a health hazard if not handled properly. State and federal regulations govern activities that disturb lead-based painted surfaces and may also require notice to building occupants. Do not remove or sand lead-based paint without consulting a qualified lead professional for guidance on lead-based paint testing and safety precautions. Armstrong Flooring does not recommend the use of solvents to remove paint, varnish, oil, wax or old adhesive residues because the solvents can remain in the subfloor and negatively affect the new installation. Whenever sanding, be certain the work site is well ventilated and avoid breathing dust. If high dust levels are anticipated, use appropriate National Institute for Occupational Safety and Health (NIOSH) designated dust respirator. All

power sanding tools must be equipped with dust collectors. Avoid contact with skin or eyes. Wear gloves, eye protection and long-sleeve, loose fitting clothes

5. For additional information on the installation and preparation of wood and board-type underlayments see the current edition of ASTM F1482, “Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring.”
6. Vacuum or broom-clean surfaces to be covered immediately before the application of flooring.

3.04 INSTALLATION OF FLOORING

A. Install flooring in strict accordance with the latest edition of Armstrong Flooring Guaranteed Installation Systems manual, F-5061. Failure to comply may result in voiding the manufacturer’s warranty listed in Section 1.08.

B. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.

C. If required, install flooring on pan-type floor access covers. Maintain continuity of color and pattern within pieces of flooring installed on these covers. Adhere flooring to the subfloor around covers and to covers.

D. Scribe, cut, and fit to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.

E. Roll with a 100-pound (45.36 kilogram) roller in the field areas. Refer to specific rolling instructions of the flooring manufacturer

F. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.

3.05 INSTALLATION OF ACCESSORIES

A. Apply top set wall base to walls, columns, casework, and other permanent fixtures in areas where top-set base is required. Install base in lengths as long as practical, with inside corners fabricated from base materials that are mitered or coped. Tightly bond base to vertical substrate with continuous contact at horizontal and vertical surfaces.

B. Fill voids with plastic filler along the top edge of the resilient wall base or integral cove cap on masonry surfaces or other similar irregular substrates.

C. Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.

D. Apply [butt-type] [overlap] metal edge strips where shown on the drawings, [before] [after] flooring installation. Secure units to the substrate, complying with the edge strip manufacturer's recommendations.

3.06 CLEANING

A. Perform initial and on-going maintenance according to the latest edition of Armstrong Flooring Maintenance Recommendations and Procedures manual, F-8663.

3.07 PROTECTION

A. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings. (See Finishing The Job in the latest edition of Armstrong Flooring Guaranteed Installation Systems manual, F-5061.)

END OF SECTION

SECTION 096813 – TILE CARPETING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and Samples.

B. Extra Materials: Deliver to Owner carpet tiles equal to 5 percent of each type and color installed, packaged with protective covering for storage.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Manufacturers: J+J Flooring Group

Local Rep:

Erik Pederson; Voice: 317-318-3341

B. Basis-of-Design Product: J+J Flooring Group, Analog Kinetex, Analog 1821, Brick Installation

C. Size: 24 inches by 24 inches

2.2 INSTALLATION ACCESSORIES

A. Carpet Adhesives: Product that complies with flammability requirements for installed carpet and is recommended by carpet manufacturer for conditions indicated.

1. Low-Emitting Materials: Adhesives shall have a VOC content of 50 g/L or less.

B. Carpet Tile Adhesives: Pressure-sensitive type that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for conditions indicated for releasable installation.

1. Low-Emitting Materials: Adhesives shall have a VOC content of 50 g/L or less.

C. Tackless Carpet Stripping: Water-resistant plywood, in strips as required to match cushion thickness and that comply with CRI 104, Section 12.2.

D. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with CRI 104.

B. Carpet Installation Method: Direct glue-down

1. Carpet Installation Method for Stairs: Glue down
2. Maintain uniformity of carpet direction and lay of pile. At doorways, center seams under door in closed position. Bind or seal cut edges as recommended by carpet manufacturer.
3. Install pattern parallel to walls and borders.

C. Carpet Tile Installation Method: As recommended by manufacturer

1. Install borders parallel to walls.

END OF SECTION 096800

SECTION 099000 - PAINTING AND COATING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:
   1. Product Data. Include printout of MPI's "MPI Approved Products List" with product highlighted.
   2. Samples.

B. Mockups: Full-coat finish Sample of each type of coating, color, and substrate, applied where directed.

C. Extra Materials: Deliver to Owner 1 gal. of each color and type of finish coat paint used on Project, in containers, properly labeled and sealed.

PART 2 - PRODUCTS

2.1 PAINT

A. Manufacturers:
   1. Benjamin Moore & Co.
   2. PPG Architectural Finishes, Inc.
   3. Sherwin-Williams Company (The).

B. that are compatible with one another and with substrates.
   1. 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.

C. Use paints and coatings that comply with the limits for VOC content:

D. Colors: As selected.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, lighting fixtures, and similar items that are not to be painted. Mask items that cannot be removed. Reinstall items in each area after painting is complete.

C. Clean and prepare surfaces in an area before beginning painting in that area. Schedule painting so cleaning operations will not damage newly painted surfaces.

3.2 APPLICATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Paint exposed surfaces, new and existing, unless otherwise indicated.
   1. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces.
   2. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Paint the back side of access panels.
   4. Do not paint prefinished items, items with an integral finish, operating parts, and labels unless otherwise indicated.

C. Apply paints according to manufacturer's written instructions.
   1. Use brushes only for exterior painting and where the use of other applicators is not practical.
   2. Use rollers for finish coat on interior walls and ceilings.

D. 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.

1. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

3.3 EXTERIOR PAINT APPLICATION SCHEDULE

A. CONCRETE MASONRY UNITS (exterior, new construction, painted finish):

1st Coat - Acrylic Block Filler

"S-W, Heavy-Duty Block Filler, Interior/Exterior Acrylic, B42W46"

*Apply filler coat at a rate to ensure complete coverage with pores filled.

2nd Coat - 100% Acrylic Emulsion Topcoat

"S-W, Pro Industrial Acrylic Semi-Gloss, B66W00651

3rd Coat - 100% Acrylic Emulsion Topcoat

"S-W, Pro Industrial Acrylic Semi-Gloss, B66W00651

B. STEEL, SHOP PRIMED (exterior, new construction, painted finish):

Touch-Up - Rust-Inhibitive Metal Primer

"S-W, Kem Bond HS, Universal Metal Primer"

*May use original primer if available.

*Color selected as most appropriate to match primer.

2nd Coat - Urethane Alkyd Topcoat

" Pro Industrial Waterbased Acrolon 100 HS Polyurethane, B65W721

3rd Coat - Urethane Alkyd Topcoat

"S-W, Pro Industrial Waterbased Acrolon 100 HS Polyurethane, B65W721

*Not less than 3.0 mils dry film thickness.

C. STEEL, GALVANIZED (exterior, new construction, painted finish):

1st Coat - Universal Primer

"S-W, PRO Industrial, Pro-Cryl, Universal Primer, B66W310
*Gray.

2nd Coat - 100% Acrylic Emulsion
"S-W, Pro Industrial Acrylic Semi-Gloss, B66W00651

3rd Coat - 100% Acrylic Emulsion
"S-W, Pro Industrial Acrylic Semi-Gloss, B66W00651
*Not less than 3.0 mils dry film thickness.

D. METAL DOORS AND FRAMES (exterior, new construction, painted finish):
Touch-Up - Rust-Inhibitive Metal Primer
"S-W Pro Industrial ProCryl Universal Acrylic Primer, B66W310
*May use original primer if available.
*Color selected as most appropriate to match primer.

2nd Coat - Urethane Alkyd Topcoat
"S-W, Pro Industrial Waterbased Acrolon 100 HS Polyurethane, B65W721

3rd Coat - Urethane Alkyd Topcoat
"S-W, Pro Industrial Waterbased Acrolon 100 HS Polyurethane, B65W721
*Not less than 3.0 mils dry film thickness.
*Additional coats as required by Architect to achieve desired and intended result.

3.10 PAINT SYSTEM SCHEDULE - INTERIOR PAINT SYSTEMS

A. CONCRETE MASONRY UNITS (epoxy coating):
1st Coat - Acrylic Block Filler
"S-W, Heavy-Duty Block Filler, Interior/Exterior Acrylic, B42W46"
*Apply filler coat at a rate to ensure complete coverage with pores filled.
2nd Coat - Pre-Catalyzed WB Epoxy Topcoat
"S-W, Pro-Industrial Pre-Catalyzed Water Based Epoxy" K46-150 Series Series, Semi-Gloss

3rd Coat - Pre-Catalyzed WB Epoxy Topcoat
"S-W, Pro Industrial Pre-Catalyzed Water Based Epoxy" K46-150 Series Series, Semi-Gloss

C. GYPSUM DRYWALL / PLASTER CEILING AND SOFFIT SURFACES
1st Coat - Latex Primer
"S-W, PrepRite ProBlock, Interior/Exterior Latex Primer/Sealer, "B51W620
*Painter responsible to visit site and field verify surface prep required.
*Additional coats as required to cover existing color and texture.
2nd Coat - Pre-Catalyzed WB Topcoat Epoxy Topcoat
"S-W, Pro-Industrial Pre-Catalyzed Water Based Epoxy" K45-150 Series, Eg-shel

3rd Coat - Pre-Catalyzed WB Epoxy Topcoat

09900-12
"S-W, Pro-Industrial Pre-Catalyzed Water Based Epoxy"
K45-150 Series, Eg-shel

E. STEEL, SHOP PRIMED (interior, new construction, painted finish):
Touch-Up - Rust-Inhibitive Metal Primer
"S-W, Kem Bond HS, Universal Metal Primer"
*May use original primer if available.
*Color selected as most appropriate to match primer.

2nd Coat - Urethane Alkyd Topcoat
"S-W, Pro Industrial Waterbased Alkyd Urethane Gloss, B53W1051

3rd Coat - Urethane Alkyd Topcoat
"S-W, Pro Industrial Waterbased Alkyd Urethane Gloss, B53W1051
*Not less than 3.0 mils dry film thickness.

F. STEEL, GALVANIZED (interior, new construction, painted finish):

1st Coat - Solvent-Based Acrylic Coating

"S-W, Pro Industrial ProCryl Universal Acrylic Primer, B66W310

2nd Coat - Urethane Alkyd Topcoat

"S-W, Pro Industrial Acrylic Gloss, B66W611

3rd Coat - Urethane Alkyd Topcoat

"S-W, " Pro Industrial Acrylic Gloss, B66W611

*Not less than 3.0 mils dry film thickness.

G. METAL DOORS AND FRAMES (interior, new construction, painted finish):

Touch-Up - Rust-Inhibitive Metal Primer

"S-W, Pro Industrial ProCryl Universal Acrylic Primer, B66W310

*May use original primer if available.

*Color selected as most appropriate to match primer.

2nd Coat - Urethane Alkyd Topcoat

"S-W, Pro Industrial Waterbased Alkyd Urethane Gloss, B53W1051

3rd Coat - Urethane Alkyd Topcoat

"S-W, Pro Industrial Waterbased Alkyd Urethane Gloss, B53W1051

*Not less than 3.0 mils dry film thickness.

*Additional coats as required by Architect to achieve desired and intended result

END OF SECTION 099000

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and application of wood finishes on the following substrates:

1. Interior Substrates:
   a. Dressed lumber (finish carpentry).

1.2 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

D. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

E. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.

B. Samples: For each type of finish system and in each color and gloss of finish indicated.

C. Product List: For each product indicated, include printout of current "MPI Approved Products List" for each product category specified in Part 2, with the product proposed for use highlighted.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Stains and Transparent Finishes: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.

a. Vertical and Horizontal Surfaces: Provide samples of at least 4 LIN. ft.
b. Other Items: Architect will designate items or areas required.

2. Final approval of stain color selections will be based on mockups.

a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, [provide product] [provide one of the products] [available products that may be incorporated into the Work include, but are not limited to products] listed in other Part 2 articles for the category indicated.

2.2 MATERIALS, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each finish 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 finish system, provide products recommended in writing by manufacturers of topcoat for use in finish system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction[and, for interior stains and finishes applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].

1. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
2. Shellacs, Clear: VOC not more than 730 g/L.
3. Stains: VOC not more than 250 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.

D. Low-Emitting Materials: Interior stains and finishes 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."

E. Stain Colors: As selected by Architect from manufacturer's full range.

F. Stain, Semi-Transparent, for Interior Wood: MPI #90.

2.3 POLYURETHANE VARNISHES

A. Varnish, Interior, Polyurethane, Oil-Modified, Satin (Gloss Level 4): MPI #57.

B. Varnish, Polyurethane, Moisture-Cured, Gloss (Gloss Level 6):[MPI #31.]

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 the Work.

B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

C. Maximum Moisture Content of Interior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with finish application only after unsatisfactory conditions have been corrected.

1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Manual."

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 EXTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood substrates, nontraffic surfaces, including [wood trim] [architectural woodwork] [doors] [windows] [wood siding] [wood fences] [wood-based panel products] [glued-laminated construction] [exposed joists] [exposed beams] [wood shingles and shakes (excluding roofs)] <Insert description>.

1. Solid Hide, Water-Based Stain System:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.
b. Prime Coat: Primer, oil for exterior wood, MPI #7.
c. Intermediate Coat: Stain, exterior, water based, solid hide, matching topcoat.
d. Topcoat: Stain, exterior, water based, solid hide, MPI #16.

2. Solid Hide, Water-Based Stain System:

a. Prime Coat: Primer, latex for exterior wood, MPI #6.
b. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

c. Prime Coat: Primer, oil for exterior wood, MPI #7.
d. Intermediate Coat: Stain, exterior, water based, solid hide, matching topcoat.
e. Topcoat: Stain, exterior, water based, solid hide, MPI #16.

3. Solid Hide, Solvent-Based Stain System:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.
b. Prime Coat: Primer, oil for exterior wood, MPI #7.
c. Intermediate Coat: Stain, exterior, solvent based, solid hide, matching topcoat.
d. Topcoat: Stain, exterior, solvent based, solid hide, MPI #14.

4. Semitransparent Stain System:

a. Prime Coat: Stain, exterior, solvent based, semi-transparent, matching topcoat.
b. Topcoat: Stain, exterior, solvent based, semi-transparenT, MPI #13.

5. Varnish over Semitransparent Stain System:

a. Stain Coat: Stain, exterior, solvent based, semi-transparent, MPI #13.
b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV Inhibitor, Exterior, Semi-Gloss (Gloss Level 5), MPI #30.
e. Topcoat: Varnish, with UV Inhibitor, Exterior, Gloss (Gloss Level 6), MPI #29.
f. Topcoat: Varnish, Marine Spar, Exterior, Gloss (Gloss Level 7), MPI #28.

6. Varnish System:

a. Prime Coat: Varnish matching topcoat.
b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV Inhibitor, Exterior, Semi-Gloss (Gloss Level 5), MPI #30.
e. Topcoat: Varnish, with UV Inhibitor, Exterior, Gloss (Gloss Level 6), MPI #29.
f. Topcoat: Varnish, Marine Spar, Exterior, Gloss (Gloss Level 7), MPI #28.

7. Clear, Two-Component Polyurethane Varnish over Stain System:

a. Stain Coat: Stain, exterior, solvent based, semi-transparent, MPI #13.
b. First Intermediate Coat: Varnish, aliphatic polyurethane, two-component, matching topcoat.
c. Second Intermediate Coat: Varnish, aliphatic polyurethane, two-component, matching topcoat.
d. Topcoat: Varnish, aliphatic polyurethane, two-component (Gloss Level 6 or 7), MPI #78.

8. Clear, Two-Component Polyurethane Varnish System:

   a. Prime Coat: Varnish, aliphatic polyurethane, two-component, matching topcoat.
   b. Intermediate Coat: Varnish, aliphatic polyurethane, two-component, matching topcoat.
   c. Topcoat: Varnish, aliphatic polyurethane, two-component (Gloss Level 6 or 7)[, MPI #78].

B. Wood substrates, traffic surfaces, including wood decks and stairs.

1. Deck Stain over Wood Preservative System:

   a. Preservative Coat: Preservative, for exterior wood, MPI #37.
   b. Intermediate Coat: Stain, for exterior wood decks, matching topcoat.
   c. Top coat: Stain, for exterior wood decks, MPI #33.

2. Deck Stain System:

   a. Prime Coat: Stain, for exterior wood decks, matching topcoat.
   b. Top coat: Stain, for exterior wood decks, MPI #33.

3.6 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood substrates, nontraffic surfaces, including wood trim architectural woodwork, doors.

1. Polyurethane Varnish over Stain System:

   a. Stain Coat: Stain, semi-transparent, for interior wood, MPI #90.
   b. First Intermediate Coat: Polyurethane varnish matching topcoat.
   c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
   d. Topcoat: Varnish, interior, polyurethane, oil-modified, gloss (Gloss Level 6), MPI #56.

END OF SECTION 099300

SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data, Shop Drawings, and Samples.

PART 2 - PRODUCTS

2.1 SIGNS, GENERAL

A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines

2.2 PANEL SIGNS

A. Interior Panel Signs: Engraved plastic laminate with square-cut edges and rounded corners.

1. Finishes and Colors: As selected from manufacturer's full range
2. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch above surface with contrasting colors (room names and numbers).
3. Provide signs for all rooms mounted on the wall beside the room door:

2.3 MATERIALS

A. Plastic Laminate: High-pressure laminate engraving stock with face and core in contrasting colors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate signs where indicated or directed by Architect. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.

B. Dimensional Characters: Mount characters with backs in contact with wall surface

END OF SECTION 101400

SECTION 101416 - PLAQUES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes plaques.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For plaques.

1. Include fabrication and installation details and attachments to other work.
2. Show plaque mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each plaque at least half size

C. Samples: For each exposed product and for each color and texture specified.

D. Plaque Schedule: Use same designations specified or indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of plaques that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PRODUCTS

1.6 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

1.7 PLAQUES

A. Cast Plaque See drawings for size. Plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Ace Sign Systems, Inc.
   b. Allen Markings International.
   c. APCO Graphics, Inc.
   d. A. R. K. Ramos Signage Systems.
   e. Diskey Sign Company.
   f. Erie Landmark Company; Division of Paul W. Zimmerman Foundries.
   g. Gemini Incorporated.
   h. Matthews International Corporation; Bronze Division.
   i. Metal Arts; Division of L & H Mfg. Co.
   j. Metallic Arts.
   k. Nelson-Harkins Industries.
   l. Southwell Company (The).
   m.

3. Plaque Material: Cast aluminum
4. Plaque Thickness: 0.50 inch
5. Finishes:

   a. Integral Metal Finish: As selected by Architect from full range of industry finishes
   b. Integral Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities
   c. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range
   d. Overcoat: Manufacturer's standard baked-on clear coating

6. Background Texture: As selected by Architect from manufacturer's full range
7. Integrally Cast Border Style: Square single line, polished
8. Mounting: As indicated

1.8 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of plaques, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.

2. Plaque Mounting Fasteners:

a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque, unless otherwise indicated.

B. Adhesives: As recommended by plaque manufacturer and with a VOC content of 70 g/L or less for adhesives used inside the weatherproofing system and applied on-site when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Adhesives: As recommended by plaque manufacturer and that 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."

1.9 FABRICATION

A. General: Provide manufacturer's standard plaques according to requirements indicated.

1. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
3. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match plaque finish.
4. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into panel surface indicated to produce precisely formed copy, incised to uniform depth.

1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.

C. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted plaques to suit plaque construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match plaque-background color color unless otherwise indicated.

PART 2 - EXECUTION

2.1 INSTALLATION

A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.

1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.
2. Install plaques so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that plaque surfaces are clean and free of materials or debris that would impair installation.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place plaque in position and push until flush to surface, embedding studs in holes. Temporarily support plaque in position until adhesive fully sets.
b. Thin or Hollow Surfaces: Place plaque in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Through Fasteners: Drill holes in substrate using predrilled holes in plaque as template. Countersink holes in plaque if required. Place plaque in position and flush to surface. Install through fasteners and tighten.
3. Brackets: Remove loose debris from substrate surface and install bracket supports in position so that plaque is correctly located and aligned.
4. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of plaque and of suitable quantity to support weight of plaque after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as plaque is applied and to prevent visibility of cured adhesive at plaque edges. Place plaque in position, and push to engage adhesive. Temporarily support plaque in position until adhesive fully sets.

C. Remove temporary protective coverings and strippable films as plaques are installed.
END OF SECTION 101416

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Solid Color Reinforced Composite toilet compartments configured as toilet enclosures and urinal screens.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for each exposed product and for each color and texture specified.

D. Product certificates.

E. Maintenance data.

1.3 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Regulatory Requirements: Comply with applicable provisions in [the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" for toilet compartments designated as accessible.

PART 2 - PRODUCTS

2.1 Solid Color Reinforced Composite

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

B.
   1. Scranton Products, 1” Solid HDPE Partitions
      a. Overhead Braced and Floor Mounted

b. Color: TO be selected from samples provided.

C. Toilet-Enclosure Style: Floor Mounted and Overhead braced

D. Urinal-Screen Style: Wall hung with continuous hinge.

E. Pilaster Shoes: Fabricated from stainless-steel sheet, not less than 3 inches high, finished to match hardware.

F. Brackets (Fittings): Manufacturer’s standard design.

2.2 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with anti-grip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.3 FABRICATION

A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

B. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

B. Clearances: Maximum 1/2 inch between pilasters and panels; 1 inch between panels and walls.

C. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than [two brackets attached] [three brackets attached at midpoint and] near top and bottom of panel. Locate wall brackets so holes for wall anchors occur in masonry or tile joints. Align brackets at pilasters with brackets at walls.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102210 - PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 DESCRIPTION OF WORK

A. This Section includes the following:
1. The extent of the demountable partition or butt-glazed entrances/storefronts work as shown on the drawings, and as specified herein.
2. Provide all materials, labor, and equipment to install demountable partitions or butt-glazed entrances/storefronts. The system shall offer maximum flexibility and reusability to accommodate frequent and quick relocation work without loss of materials, damage or modification to panels or to adjoining structures such as ceilings, fixed walls and floors. The factory assembled system must be unitized or pre-assembled (not stick built), non-progressive and modular, allowing the removal of individual panels from any location without disturbing adjoining units and providing interchangeability of panels and door units on the same module.
3. The head detail shall be flush to the ceiling without a reveal. All ceiling leveling adjustment is hidden within the head detail.
4. The panel thickness at the base shall be 2” thick providing the user more usable space when space planning.
5. The base assembly with an integrated leveling system shall be permanently attached to the panel. Detached and loosely shipped floor tracks and leveling components shall not be permitted.
6. The factory assembled movable walls are very flexible to accommodate the building conditions. The wall shall have flexible vertical adjustability. An adjustable, ceiling head assembly shall provide a ± $^1/_2$” adjustment at the ceiling. At the floor, a self-contained leveling glide system and a $3^1/_4$” and 4” high base cover shall allow for floor adjustment of + 1” for a $3^1/_4$” base and + $1^3/_4$” for a 4” base. Where the wall system meets the building core walls, columns or window mullions, u-channel extrusions shall allow for horizontal adjustment.

B. Related Sections include the following:
1. Wood Doors – Section 08 14 00
2. Door Hardware – Section 08 71 00
3. Glass and Glazing – Section 08 81 00
4. Acoustical Ceilings – 09 51 00
5. Wall Finishes – Section 09 70 00
6. Electrical and Lighting– Division 26
7. Communications – Division 27

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has successfully completed demountable partition or butt-glazed entrance/storefront installations similar in material, design, and extent to that indicated for this Project and are mutually accepted by the manufacturer and the customer.

B. Performance Bond: The successful demountable partition or butt-glazed entrances/ storefronts manufacturer should have the ability to provide a performance bond to insure Project completion.

C. Sound Control: Glass panel's sound transmission will be dependent upon glass type used.

D. Indoor Air Quality: Demountable partition or butt-glazed entrances/storefronts wall manufacturer's non-wood products must meet the SCS Indoor Advantage™ Gold Certification or equivalent. This approval guarantees conformance to indoor air concentrations meeting ANSI/BIFMA M7.1-2011, California Specification 01350, and ANSI/BIFMA e3-2012 testing, conducted in an independent third-party air quality testing laboratory.

E. Glass Association of North America (GANA) Guidelines: Recommends the use of $^1/_2$" thick glass when used in butt-glazed demountable partition or entrances/storefronts mounted or restrained at the top and bottom only for ceilings from 96" to 120".

F. 2012 IBC, Section 2403.4: When two adjacent interior demountable partition or butt-glazed entrances/storefronts walls mounted or restrained at the top and bottom only are installed adjacent to a walking surface, the differential deflection shall not be greater than the thickness of the panels (glass thickness) when a force of 50 pounds per linear foot is applied horizontally to one panel at any point up to 42 inches above the walking surface.

G. 2010 ADA:

Doors Clear Width (ADA 404.2.3) Suggested Specification. Doorways shall have a minimum clear opening of 32" (815mm) with the door open 90°, measured between the face of the door and the opposite stop, and shall have 80" (2030mm) minimum clear headroom.

Doors Opening Force (ADA 404.2.9) Suggested Specification. Interior hinged, sliding or folding doors shall require no more than five pounds of force to open.

Doors Door Hardware (ADA 404.2.7) Suggested Specification. Door handles shall be levers that can be operated with a closed fist. Hardware shall be mounted no higher than 48" (1220mm) above finished floor and a minimum of 34" above finished floor.

H. 2012 IBC Section 1607.14: Interior demountable partition or butt-glazed entrances/ storefronts wall manufacturer that exceed 6 feet (1829mm) in height, including their finish materials, shall have adequate strength to resist the loads which they are subjected but not less than a horizontal load of 5psf (0.240kN/m2).

I. Certification: Include supporting certified laboratory testing data indicating that material meets specified test requirements.

J. Mock up for Verification Purposes: In a location designated by the Architect, install a full scale installation incorporating at least one of each type of panel, and accessory required, illustrating each installation condition. Retain mock up installation until completion of
total installation or dismantle earlier at the direction of the Architect. Materials used for the mock up installation will not be considered part of either the base contract materials or the attic stock materials. If life cycle costs of the product are important decision criteria, the mock up installation and reconfiguration should be timed, and the reuse of components should be evaluated.

1.4 SUBMITTALS

A. Product Data: Product data on physical characteristics, durability, resistance to fading, and flame spread characteristics for each type of partition and accessory.

B. Shop Drawings: Shop drawings showing location and extent of partitions. Include plans, elevations, sections, details, and attachments to other work.

C. Samples:

1. Samples for Initial Selection: Samples for initial selection purposes in form of manufacturer's standard color charts showing full range of colors, textures, and patterns available for each type of material exposed to view.
2. Samples for Verification: For each type of exposed finish required, prepared on. Samples of size indicated below.
   a. Panel Finish Face: Manufacturer's standard-size unit, but not less than 3 inches (75mm) square.
   b. Base Trim: 12 inches (300mm) long Samples.
   c. Door Finish Face: Manufacturer's standard-size unit, but not less than 3 inches (75mm) square.
   d. Glazing: Manufacturer's standard-size unit, but not less than 3 inches (75mm) square.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of demountable partition or butt-glazed entrance/ storefront.

E. Contract Closeout Information:

1. Warranty.
2. Maintenance Data: For demountable partitions or butt-glazed entrances/storefronts to include in maintenance manuals.
   a. Recommended cleaning materials and warnings about cleaning methods that could be detrimental to finishes and performance.
   b. Installation manual detailing methods to move reuse and adjust demountable partition or butt-glazed entrance/storefront product.

1.5 PROJECT CONDITIONS

A. Delivery, Storage, and Handling: Deliver materials to Project Site in original factory wrappings and containers/skids, clearly labeled with identification of manufacturer, brand name, model number and order number. Store materials in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity; store product according to installation manual and away from other trades.

B. Environmental Limitations: Do not deliver or install demountable partitions or butt-glazed entrance/storefront components until building is enclosed and finishing operations, including ceiling and floor-covering installation and painting, are complete.

C. Field Measurements: Indicate measurements on Shop Drawings.

D. Coordination of Work: Coordinate layout and installation of demountable partitions or butt-glazed entrance/storefront components with other units of Work. Installation of ceilings, floor coverings, lighting fixtures, HVAC equipment, and fire-suppression systems should be completed before demountable partitions are installed.

E. Special Requirements: Comply with instructions and recommendations of manufacture for special delivery, storage, and handling requirements.

1.6 EXTRA MATERIALS

Deliver to the Owner, not less than three percent of the Project total for each

component, panel and accessory of each type, color, and finish of demountable partition or butt-glazed entrance/storefront system exclusive of material required to properly complete installation. Furnish accessory components and installation tools as indicated on schedule. Furnish extra materials from same production run as materials installed. Package extra materials with protective covering, identified with appropriate labels.

1.7 WARRANTY

Demountable or butt-glazed entrance/storefront system glazed units, door frames, and related components to be without defects in material or workmanship for a period of ten (10) years from the date of delivery. Wood doors shall be warranted for ten (10) years from the date of delivery, subject to the manufacturer's terms and conditions. Third party supplied product such as door hardware and film applied to glass will be warranted based on their own warranty terms.

This warranty does not cover defects or damage resulting from accidents, misuse, improper relocation methods or transfer to storage. Plastic laminates, and wood veneer finishes are not warranted against fading or wearing, or if improperly cleaned or treated by the Owner or by others.

1.8 NON-OBSOLENCE

Demountable or butt-glazed entrance/storefront system components and parts, with exception of third party supplied product (such as door hardware, glass, film applied to glass) are guaranteed to be compatible and available for purchase for ten years from the date of
the original order.

PART 2 - PRODUCTS

2.1 DEMOUNTABLE PARTITIONS OR BUTT-GLAZED ENTRANCE/ STOREFRONT

A. Products: Subject to compliance with requirements, provide the Basis-of-Design Product, or one of the following:
   1. TBD
   2. Other manufacturers desiring approval comply with Section 00440

B. Basis-of-Design Product: Subject to compliance with requirements, provide KI "Lightline" demountable partition or butt-glazed entrance/storefront.

C. Butted Glass Panel-to-Panel Glazing Seal:
   1. Inline Joint Seal Type: Factory-installed VHB tape dry glass seal and $^1/_4$" rigid seal
   2. Frameless Corner Glass Overlap (not-mitered) Glazing Seal Type: Factory-installed VHB tape dry glass seal and $^1/_8$" rigid seal
   3. Angled and Faceted Curve Seal Type: Factory Installed VHB tape dry glass seal and $^1/_2$" polycarbonate rod rigid seal

D. Glass and Glazing: Safety glazing in compliance with Glass and Glazing – Section 08 81 00.
   1. Single Glazed Thickness: $^1/_2$"
   2. Glass Type: Tempered or Laminate
   3. Exposed Glass Edge Type: Polished and Aris (chamfered)
   4. Glass Panel Configuration: Single Center mounted

E. Aluminum Trim: Base trim is continuous to 10', factory-finished, snap-on type adjustable for variations in floor. Ceiling trim is continuous to 10' and ceiling irregularities are hidden.
   1. Base Trim Height: 4"
   2. Ceiling Trim Profile: 3" Flush
   3. Exposed-Metal Trim Finish: Clear Anodized
   4. Trim Color: As selected by Architect from manufacturer's full range
   5. Typical Corner Ceiling Trim: Outside corner is mitered in the field
   6. Typical Corner Base Trim: Outside corner is mitered in the field

F. Post Connections:

1. Universal Post Configuration Demising Wall. Please denote typical wall connection: $2^{1}/_{8}$" Lightline
2. Permanent Drywall Connection (Connection sealed with gasket): U-Channel

G. Wood Door Leaves: Manufacturer's standard 5-ply construction and $1^3/_4$ inches (45mm) thick. Leaves should be constructed with no visible stop. Standard core material is Timber strand which is considered a rapidly renewable material. Standard stile/rail thickness is 5".

1. Door Veneer Type: rotary white birch
2. Door Veneer Finish: espresso
3. Door Leaf Type: Fully-Glazed
4. FSC Veneer: No
5. Glass Insert (if applicable): <Insert glass type>
6. Glass Insert Thickness (if applicable): $^1/_4$"
7. Adjustable Bottom Seal to adjust for floor variances (Default Solution) included

H. $^1/_2$" Thick Frameless Glass Leaves: Manufacturer's standard $^1/_2$" tempered with polished edge.

1. Single Glazed Thickness: $^1/_2$"
2. Glass Type: Tempered
3. Exposed Glass Edge Type: Polished and Aris (chamfered)
4. Adjustable Bottom Seal to adjust for floor variances (Default Solution) included

I. Type of Door Frame: Sliding door frame track is surface-mounted and finished with a valence. Optional double acting soft stop mechanism is available. Pivot hinge is reversible. Door frame units are pre-assembled or unitized.

1. Frame Height: Ceiling height
2. Transom Height Finish (if applicable):
3. Frame Type: Single Reversible Pivot
4. Frame Finishes: Clear Anodized
5. Frame Color: As selected by Architect from manufacturer's full range
6. Vertical Post Size: $2^1/_8$"
7. Optional Door Seal on vertical posts and along horizontal top: No

J. Door Hardware: As specified in Hardware Section 08 71 00

K. Seals: Manufacturer's standard.

2.2 FABRICATION

A. Demountable or butt-glazed entrance/storefront panels: Factory-assembled, butt-glazed pre-assembled glass units (not stick-built or site built). Fabricate panels for installation with concealed fastening devices and pressure-fit components that will not damage ceiling or floor coverings. Fabricate panels with continuous light-and-sound seals at floor, ceiling, and other locations where panels abut fixed construction.

B. Components: Fabricate components for installation with concealed fastening devices and pressure-fit members that will not damage ceiling or floor coverings. Fabricate for installation with continuous seals at floor, ceiling, and other locations where partition assemblies abut fixed construction and for installation of sound attenuation insulation in partition cavities.

2.3 FINISHES, GENERAL

A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to installation of demountable or butt-glazed entrance/storefront system, clean floor to remove dust, debris, and loose particles.

B. Illuminate areas of installation to provide an ambient light level of at least 100 foot candles measured in the area where partitions are to be installed.

C. Maintain temperature in the area of installation at a constant minimum of 65° F with relatively humidity less than 70 percent for a period of 48 hours prior to installation and during installation process.

D. General Contractor will deliver all GWB construction interfacing with the demountable or movable partition system in true and plumb condition.

E. For manufacturer to accept responsibility of dimensional compatibility between demountable or movable partition wall system and GWB construction, manufacturer shall have access to the completed GWB for accurate field measuring eight weeks prior to requiring product on site to commence installation. If time line does not permit the eight weeks lead time, demountable manufacturer shall provide "hold-to" dimensions for the General Contractor. General Contractor then assumes responsibility that GWB construction delivers on "hold-to" dimensions.

F. Demountable or butt-glazed entrance/storefront manufacturer determines that conditions are acceptable to receive the work of this section. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to installer. Starting of work shall be construed as acceptance of conditions.

3.2 INSTALLATION

A. Install Demountable or butt-glazed entrance/storefront systems rigid, level, plumb, and aligned. Install seals to prevent light and sound transmission at connections to floors, ceilings, fixed walls, and abutting surfaces.
   1. Installation Tolerance: Install each demountable partition so surfaces vary not more than $^{1}/_{8}$ inch (3mm) from the plane formed by the faces of adjacent partitions.

B. Do not alter ceiling suspension system.

C. Install door-and-frame, and glazing-and-glazing-frame assemblies securely anchored to partitions and with doors aligned and fitted. Install and adjust door hardware for proper operation.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to demonstrate and train Owner's maintenance personnel to adjust, operate, and maintain Demountable or butt-glazed entrance/storefront system. Refer to Division 01 Section "Demonstration and Training."

SECTION 102226.13 - ACCORDION FOLDING PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated, accordion folding partitions.

1.2 PERFORMANCE REQUIREMENTS

A. Acoustical Performance: Provide accordion folding partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:

1. Sound-Transmission Requirements: STC tested according to ASTM E 90 and calculated according to ASTM E 413.
2. Noise Reduction Requirements: Tested sound-absorption performance according to ASTM C 423.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Indicate storage and operating clearances.
2. Indicate facing-material seam locations if any.

C. Samples: For each exposed product and for each color and texture specified. Size for textiles shall be full width by not less than 36-inches long, showing complete pattern repeat.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, based on input from installers of the items involved.

B. Product certificates.

C. Material Certificates: For each textile dye lot.

D. Product test reports.

E. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Preparation of the opening shall conform to the dimensions specified, plumb, level, and in accordance to building practices.

C. Acoustical Performance: Test partitions in an independent acoustical laboratory in accordance with ASTM E90 to attain no less than the STC rating specified. Provide a complete and unedited written test report by the testing laboratory upon request

D. Preinstallation Conference: Conduct conference at Project site.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of accordion folding partitions that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACCORDION FOLDING PARTITION

A. Accordion Folding Partition: Accordion folding frame with pantograph sections designed for horizontal extension and retraction, covered with decorative facing material, reinforced for hardware attachment, supported by overhead suspension system, and equipped with manufacturer's standard air-release method to prevent billowing.

1. Manufacturers: Subject to compliance with requirements, provide products by the following
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Modernfold, Inc.; a DORMA Group company Soundmaster 12.

B. Partition Type: As indicated on Drawings with the following hardware:

1. Lead Post Latching Hardware: Latch on both sides secured to surface jamb striker
2. Lead Post Locking Hardware: Key-operated lock cylinder, keyed to master key system, operable from both sides of post.
3. Lead Post Locking Hardware: Deadlock to receive cylinder, operable from both sides of post. See Section 087100 "Door Hardware" and Section 087111 "Door Hardware (Descriptive Specification)" for lock cylinder and keying requirements.

C. STC Rating: 40.

D. Facing Material: Vinyl film

1. Color/Pattern: As selected by Architect from manufacturer's full range

2.2 COMPONENTS

A. Posts and Seals: Provide types of posts and seals that produce accordion folding partitions complying with performance requirements.

1. Posts: Steel or aluminum; formed with deep-nesting and interlocking interfaces and fabricated to ensure rigidity of accordion folding partition.
2. Perimeter Seals: Manufacturer's standard vinyl, neoprene, or woven silica vertical seals, horizontal top and bottom seals, and closures for lead posts and jambs.[Seals and closures at fire-rated partitions shall be identical to products tested for fire rating indicated and shall form an effective smoke and draft seal.]

B. Hardware: Manufacturer's standard manually operated pulls, latches, locks, and bolts as required to operate accordion folding partitions; with decorative, protective finish.

2.3 SUSPENSION SYSTEMS

A. Suspension Tracks: Steel or aluminum designed for type of operation, size, and weight of accordion folding partition indicated. Size track to support partition operation and storage without damage to suspension system, accordion folding partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.

1. Track: Recessed; with factory-applied, decorative, protective finish

B. Carriers: Trolley system as required for size and weight of partition and for easy, quiet operation; with ball-bearing carriers at lead post and ball-bearing carriers at intermediate panel supports.

C. Track Switches and Accessories: Manufacturer's standard switches as required for type of operation, storage, track configuration, and layout indicated.

D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.

E. Steel Finish: Factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

2.4 FACING MATERIALS

A. General: Provide facing materials with appropriate backing that comply with indicated fire-test-response characteristics, and that are factory attached to accordion folding partitions with concealed fasteners.

1. Factory-apply facing material free of air bubbles, wrinkles, blisters, and other defects; in one-piece, seamless; with vertical invisible seams complying with Shop Drawings for location; and with no gaps or overlaps. Tightly secure and conceal raw and selvage edges of facing material for finished appearance. Horizontal butted edges or seams are not permitted.
2. Where facing material with directional or repeating pattern, directional weave, or matching grain is indicated, mark facing-material top and attach facing material in same direction.

B. Vinyl Film: Manufacturer's standard vinyl film laminated to partition substrate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with ASTM E 557 except as otherwise required by accordion folding partition manufacturer's written installation instructions. Install accordion folding partitions level and plumb, with tight joints and uniform appearance, and free of deformation and surface and finish irregularities.

B. Install accordion folding partitions and accessories after other finishing operations, including painting, have been completed.

C. Fire-Rated Accordion Folding Partitions: Verify that operations are functional and comply with requirements of authorities having jurisdiction.

3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain accordion folding partitions.

END OF SECTION 102226.13

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

C. Maintenance data.

D. Warranty: Sample of special warranty.

1.3 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.

1.4 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 PUBLIC-USE WASHROOM ACCESSORIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. A & J Washroom Accessories, Inc.

2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
6. Tubular Specialties Manufacturing, Inc.

B. Toilet Tissue (Roll) Dispenser:

1. Basis-of-Design Product: As specified on Interior Elevation sheets.
2. Description: Double-roll dispenser
3. Mounting: Partition mounted serving two adjacent toilet compartments
4. Controlled-delivery units cannot be used at accessible toilets.
5. Capacity: Designed for 5 ¼" diameter tissue rolls.
6. Material and Finish: Satin finish stainless steel.

C. Liquid-Soap Dispenser

1. Basis-of-Design Product: As specified on Interior Elevation sheets.
2. Description: Manual Soap Dispenser.
3. Mounting: Wall mounted

D. Grab Bar

1. Basis-of-Design Product: As specified on Interior Elevation sheets.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
4. Configuration and Length: As indicated on Drawings

E. Vendor

1. Basis-of-Design Product: As specified on Interior Elevation sheets
2. Type: napkin/ tampon
3. Mounting: recessed.
4. Capacity: 22 tampons 31 napkins
5. Operation: Two coin (50 cents)
6. Exposed Material and Finish: Satin Stainless Steel
7. Lockset: Tumbler type with separate lock and key for coin box.

F. Mirror Unit

1. Basis-of-Design Product: As specified on Interior Elevation sheets
2. Frame: Stainless-steel channel.
3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.

   a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
   b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

4. Size: As indicated on Drawings

I. NOTE Interior Elevation SHEETS. SOME ACCESSORIES NOT LISTED ABOVE BUT ARE REQUIRED BASED ON DRAWING SPECIFICATIONS.

2.2 FABRICATION

A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units' level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

END OF SECTION 102800

SECTION 104413 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

B. Fire-Rated, Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

PART 2 - PRODUCTS

2.1 FIRE-PROTECTION CABINETS

A. Fire-Protection Cabinets: Enameled-steel, semi-recessed cabinets for fire extinguisher.
   1. Available Products:
      a.
      b. Larsen Manufacturing Co. , Cameo Series, Model # C2409-6R, steel, w/ 2 ½” rolled edge, bubble design- clear no letters
      c.
   2. Trim Style: Rolled trim.
   3. Door and Trim Material: Enameled steel.
   4. Door Glazing: Acrylic bubble.
   5. Door Style: Full bubble with frame.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cabinets at 54 inches above finished floor to top of cabinet.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

B. Fire Extinguishers: NFPA 10, listed and labeled for the type, rating, and classification of extinguisher.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHERS

A. Portable Fire Extinguishers:
   1. Available Products:
      a. Larsen Manufacturing Co. MP Series, Model # MP10
   2.
   3. Multipurpose Dry-Chemical Type: UL-rated 4-A:80-B:C, 10-lb (4.5-kg) nominal capacity.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fire extinguishers in cabinets where indicated on Floor Plan.

END OF SECTION 104416

SECTION 11 52 13 - SURFACE-MOUNTED FRONT PROJECTION SCREEN

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrically operated, surface mounted, front projection screens.

1.2 REFERENCES

A. NFPA 70 - National Electrical Code.

B. NFPA 701-99 - Fire Tests for Flame-Resistant Textiles and Films.

C. GREENGUARD Environmental Institute Gold.

D. US Green Building Council.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Wiring diagram for electrically operated units.

D. Shop Drawings: Shop drawings showing layout and types of projection screens. Show the following:
1. Location of screen centerline.
2. Location of wiring connections.
3. Seams in viewing surfaces.
4. Detailed drawings for concealed mounting.
5. Connections to suspension systems.
6. Anchorage details.
7. Accessories.
8. Frame details.

E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

F. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain each type of projection screen required from a single manufacturer as a complete unit, including necessary mounting hardware and

accessories.

B. Coordination of Work: Coordinate layout and installation of projection screens with other construction supported by, or penetrating through, ceilings, including light fixtures, HVAC equipment, fire-suppression system, and partitions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver projection screens until building is enclosed and other construction where screens will be installed is substantially complete.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Protect screens from damage during delivery, handling, storage, and installation.

1.6 COORDINATION

A. Coordinate work with installation of ceilings, walls, electric service power characteristics, and location.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Draper, Inc., which is located at: 411 S. Pearl P. O. Box 425; Spiceland, IN 47385-0425; Toll Free Tel: 800-238-7999; Tel: 765-987-7999; Fax: 866-637-5611; Email:request info (drapercontract@draperinc.com); Web:www.draperinc.com

B. Substitutions: permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 MOTORIZED, SURFACE MOUNTED, FRONT PROJECTION SCREENS

A. Targa: Electric motor operated, steel case. Cases for sizes through 12 feet x 12 feet AV, 200 inch NTSC, 184 inch HDTV and 189 inch 16:10, are one piece 22 gauge steel with end caps forming universal wall or ceiling hanging bracket. Cases for sizes above 12 feet x 12 feet AV, 200 inch NTSC, 184 inch HDTV and 189 inch 16:10 consists of a curved front and L-shaped back/top cover fabricated of extruded aluminum, with endcaps forming ceiling hanging bracket. White scratch resistant textured finish.
   1. Motor mounted inside screen roller on rubber isolation insulators. Motor UL certified, rated 110-120V AC, 60 Hz, three wire, instantly reversible, lifetime lubricated with pre-set accessible limit switches.
   2. Motor Screen Controls, UL certified.
      a. Single station control rated 115V AC, 60 Hz with 3-position rocker switch with cover plate to stop or reverse screen at any point.
      b. Low voltage control unit with three button 24V switches and cover plate to stop or reverse screen at any point, built-in RF receiver, built-in Video Interface Control trigger for 3V-28V, RS232, and dry contact relays.

c. Locking switch cover plate for limited access to three position switch.
d. Key operated 3-position control switch with key locking cover plate rated 115V AC, 60 Hz to stop or reverse screen at any point.
e. 3-position low voltage control switch rated 24V to stop or reverse screen at any point.
f. Motor shall be right mounted (screen will be reverse rolled).

3. System Options:
   a. Case finished white.
   b. Floating Mounting Brackets for mounting screen to wall or ceiling.
4. Projection Viewing Surface:
   a. Matt White XT1000E - On Axis gain of 1.0. 180 degree viewing cone. Washable surface. GREENGUARD Gold certified.
5. Viewing Area H x W.
   a. HDTV Format (16:9). Black masking borders standard.
      1) 220 inch (5.59 m) diagonal, 106 inches x 188 inches

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Verify rough-in openings are properly prepared.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install front projection screens with screen cases in position and relationship to adjoining construction as indicated, securely anchored to supporting substrate, and in manner that produces a smoothly operating screen with plumb and straight vertical edges and plumb and flat viewing surfaces when screen is lowered.

C. Test electrically operated units to verify that screen, controls, limit switches, closure and other operating components are in optimum functioning condition.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 116143 - STAGE CURTAINS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes stage curtains and draw-curtain tracks.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for stage curtains. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each fabric and for each color and texture specified, full width by 36 inches (900 mm) in size, from dye lot to be used for the Work, with specified treatments applied.

D. Delegated-Design Submittal: For rigging indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of stage curtains.

B. Fire-Test-Response Characteristics: Provide stage curtains with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Flame-Resistance Ratings: Passes NFPA 701.

a. Permanently attach label to each fabric of curtain assembly indicating whether fabric is inherently and permanently flame resistant or treated with

flame-retardant chemicals, and whether it requires retreatment after designated time period or cleaning.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of rigging equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CURTAIN FABRICS

A. Medium Weight Woven Cotton Velour: Napped fabric of 100 percent cotton weighing not less than 20 oz./linear yd. (620 g/linear m) before flame-retardant treatment, with pile height not less than 75 mils (1.9 mm); 54-inch (1372-mm) minimum width.

1. Products: Subject to compliance with requirements: basis of design: 100% cotton

a. Dazian LLC; Allure.
b. Frankel/Fabric One; 650.
c. JB Martin Company; #2603 Concertino.
d. J. L. de Ball America, Inc.; Sydney.
e. KM Fabrics, Inc.; Marvel.
f. Valley Forge Fabrics, Inc.; 2020 Velour.
g. Marvel, 2002

2. Color: As selected by Architect from manufacturer's full range.

2.2 CURTAIN FABRICATION

A. General: Affix permanent label, stating compliance with requirements of authorities having jurisdiction, in accessible location on curtain not visible to audience. Provide vertical seams unless otherwise indicated. Arrange vertical seams so they do not fall on faces of pleats. Do not use fabric cuts less than one-half width.

B. Walk-Along Manual Operation: Fabricate curtain track without cord, cable, pulleys, or floor block.

C. Manual Operation: Fabricate curtain track with cord, pulleys, and floor block.

2.3 STEEL-CURTAIN TRACK

A. Steel Track: Fabricate of roll-formed, galvanized, commercial-quality, zinc-coated steel sheet; complying with ASTM A 653/A 653M; G60 (Z180) coating designation with continuous bottom slot and with each half of track in one continuous piece.

1. Products: Subject to compliance with requirements: basis of design: see other sheet.

a. Automatic Devices Company;
b. H & H Specialties Inc.; 400 series.

B. Clamp and Bracket Hangers: Manufacturer's steel clamps and brackets of sufficient strength required to support loads for attaching track to overhead support.

C. Track Lap Clamp: Metal to match track channel for attaching double-sectioned track at center overlap.

D. Fold Guide: Equip carriers with rear-fold or backpack guide and rubber spacers to permit offstage curtain folding; sized for use with operating line if any.

E. Curtain Rails: Provide end stops for track rails.

F. Curtain Carriers: Standard carriers with a quantity of curtain carriers sufficient for track length, to suit curtain fabrication. Include one master carrier for each leading curtain edge.

G. Manual Operation: Provide with cord operating line consisting of manufacturer's standard [3/8-inch- (9-mm-)] diameter, stretch-resistant operating cord consisting of braided synthetic-fiber jacket over solid, synthetic-fiber, linear filaments.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Examine areas and conditions, with Installer present, for compliance with requirements for supporting members, blocking, installation tolerances, clearances, and other conditions affecting performance of stage-curtain work. Examine inserts, clips, blocking, or other supports required to be installed by others to support tracks and battens.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Install stage-curtain system according to track manufacturer's and curtain fabricator's written instructions.

D. Ceiling-Mounted Tracks: Drill track at intervals not greater than manufacturer's written instructions for spacing, and fasten directly to structure.

E. Beam-Mounted Tracks: Install tracks by suspending from manufacturer's special beam clamps securely mounted to I-beam structure at spacing, according to manufacturer's written instructions.

F. Wall-Mounted Tracks: Install tracks by suspending from manufacturer's special bracket clamps securely mounted to wall construction at spacing, according to manufacturer's written instructions.

G. Install track for center-parting curtains with not less than 24-inch (600-mm) overlap of track sections at center, supported by special lap clamps.

H. Track Hung: Secure curtains to track carriers with snap hooks.

3.2 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain stage curtains and tracks.

END OF SECTION 116143

SECTION 122200 - CURTAINS AND DRAPES (HS Choir Room to Cover Mirrors)

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes draperies and drapery tracks.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Tracks: Include maximum weights of draperies that can be supported.
2. Fabrics.

B. Shop Drawings:

1. Tracks: Show installation and anchorage details and locations of controls.
2. Draperies: Show sizes, locations, and details of installation.

C. Samples: For each exposed product and for each color and texture specified

1.3 INFORMATIONAL SUBMITTALS

A. Product certificate for each fabric treated with flame retardant.

1.4 CLOSEOUT SUBMITTAL

A. Maintenance data.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before drapery fabrication, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 DRAPERY TRACKS

A. Manually Operated Track:

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. Forest Group USA, Inc.
    b. Kirsch.
    c. Silent Gliss USA Inc.
    d. Springs Window Fashions.

2. Corded Window Covering Product Standard: Provide drapery tracks operated by pull cords complying with WCMA A 100.1.
3. Construction: Extruded aluminum, slotted for mounting at interval of not more than 24 inches (610 mm) o.c.

    a. Support Capability: Weight of drapery indicated mounted on track length indicated.
    b. Finish: Clear anodic coating.

4. Mounting Brackets: Aluminum, of type suitable for fastening track to surface indicated and designed to support weight of track assembly and drapery plus force applied to operate track.

    a. Mounting Surface: Wall.
    b. Size: Adjustable.

5. Installation Fasteners: Sized to support track assembly and drapery, and fabricated from metal compatible with track, brackets, and supporting construction. Provide two fasteners to fasten each bracket to supporting construction.
6. Operation: Cord tension pulley.

    a. Pulley Mounting Location: Wall.
    b. Draw: Two way, center opening.
    c. Operating Hardware Location: On stack side.

7. Carriers: Rollers with hooks.

    a. Master Carriers: Butt.

8. End Stops: Manufacturer's standard with track end cap.
9. Pulleys: Heavy duty.

2.2 DRAPERIES

A. Fire-Test-Response Characteristics: For fabrics treated with fire retardants, provide products that pass NFPA 701 as determined by testing of fabrics that were treated using treatment-application method intended for use for this Project by a testing and inspecting agency acceptable to authorities having jurisdiction.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Barjan Manufacturing Ltd.
2. Contract Shading Systems.
3. County Draperies, Inc.
4. Creative Draperies Inc.
5. DFB Sales Inc.
6. Fabricut.
7. Fabtex.
8. Quiltcraft Industries, Inc.
9. Standard Textile Co., Inc.
10. Wesco Fabrics, Inc.

C. Source Limitations: Obtain each color and pattern of drapery fabric and trim from one dye lot.

D. Drapery

1. Heading:

a. Pinch (French) Pleats: 200 percent fullness; four-fold (fingers) each pleat.
b. Stack Pleats: 100 percent fullness.
c. Roll Pleats: 100 percent fullness.
d. Accordion Pleats: 100 percent fullness
e. Heading Accessories:

1) Nonwoven buckram.
2) Woven snap tape
3) Hooks.

2. Drapery Fabric:
a. Designation: Velour
b. Pattern: Solid
c. Color: Navy blue
d. Textile Treatments: Stain repellent; and flame retardant, polymer type.

3. Lining Fabric:

a. Lining Type: standard
b. Manufacturer: Selected by fabricator for use with drapery fabric indicated.
c. Textile Treatments: Stain repellent; and flame retardant, polymer type.
4. Hem Weights: 1-inch- (25-mm-) square lead weights.

2.3 DRAPERY FABRICATION

A. Fabricate draperies in heading styles and fullnesses indicated. Fabricate headings to stand erect. If less than a full width of fabric is required to produce panel of specified

fullness, use equal widths of not less than one-half width of fabric located at ends of panel.

1. One-Way-Stacking Draperies: Add 5 inches (127 mm) to overall width for returns.
2. Center-Opening Draperies: Add 10 inches (254 mm) to overall width for overlap.

B. Seams: Sew vertical seams with twin-needle sewing machine with selvage trimmed and overlocked. Join widths so that patterns match and vertical seams lay flat and straight without puckering. Horizontal seams are not acceptable.

C. Side Hems: Double-turned, 1-1/2-inch- (38-mm-) wide hems consisting of three layers of fabric, and blindstitched so that stitches are not visible on face of drapery.

D. Bottom Hems: Double-turned, 4-inch- (102-mm-) wide hems consisting of three layers of fabric, and weighted and blindstitched so that weights and stitches are not visible on face of drapery.

E. Linings: Equal to widths of drapery fabric and joined to drapery fabric at top by inside invisible seam, and hand stitched at side hems and shadowed with 1-1/2-inch (38-mm) return of face fabric.

1. Bottom Hem: Blind stitch to drapery fabric.

PART 3 - EXECUTION

3.1 DRAPERY TRACK INSTALLATION

A. Install track systems according to manufacturer's written instructions, level and plumb, and at height and location in relation to adjoining openings as indicated on Drawings.

B. Isolate metal parts of tracks and brackets from concrete, masonry, and mortar to prevent galvanic action. Use tape or another method recommended in writing by track manufacturer.

3.2 DRAPERY INSTALLATION

A. Where draperies abut overhead construction, hang draperies so that clearance between headings and overhead construction is 1/4 inch (6.4 mm).

B. Where draperies extend to floor, install so that bottom hems clear finished floor by not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm).

C. Where draperies extend to windowsill, install so that bottom hems hang above sill line and clear sill line by not more than 1/2 inch (13 mm).

D. After hanging draperies, test and adjust each track to produce unencumbered, smooth operation.

E. Steam and dress down draperies as required to produce crease- and wrinkle-free installation.

F. Remove and replace draperies that are stained or soiled.

END OF SECTION 122200

SECTION 123661 - SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Solid-surface-material countertops and backsplashes.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials and sinks.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

C. Samples: For each type of material exposed to view.

PART 2 - PRODUCTS

2.1 SOLID-SURFACE-MATERIAL COUNTERTOPS

A. Configuration: Provide countertops with the following front and backsplash style:

   1. Front: Straight, slightly eased at top
   2. Backsplash: Straight, slightly eased at corner
   3. End splash: Matching backsplash

B. Countertops: 3/4-inch- thick, solid surface material with front edge built up with same material.

C. Backsplashes: 3/4-inch- thick, solid surface material.

2.2 COUNTERTOP MATERIALS

A. Certified Wood Materials: Fabricate countertops with wood and wood-based products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

B. Particleboard: ANSI A208.1, Grade M-2

C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

D. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.

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. E. I. du Pont de Nemours and Company.
   b. Formica Corporation.
   c. LG Chemical, Ltd.
   d. Wilsonart International.

2. Type: Provide Standard Type or Veneer Type made from material complying with requirements for Standard Type, as indicated unless Special Purpose Type is indicated.
3. Integral Sink Bowls: Comply with ISSFA-2 and ANSI Z124.3, Type 5 or Type 6, without a precoated finish.
4. Colors and Patterns: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

END OF SECTION 123661

Section 12 61 00: Fixed Audience Seating

PART 1 GENERAL

1.1 SUMMARY

A. Work Included in this section: Provision of floor-mounted fixed tablet arm seating, beam-mounted, including attachment, or other work required for installation unless otherwise noted.

1.2 SUBMITTALS

A. Product data including manufacturer's assembly instructions.

B. Shop drawings with layouts by manufacturer.

C. Field verified dimensions and conditions directly affecting the product or installation.

D. Letter of Certification from manufacturer stating on-site installer's successful completion of manufacturer's assembly training on specified furniture.

E. Samples:

1) Minimum 5" x 5" fabric samples
2) Finish color selection
3) Other samples as requested

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store delivered in clean, safe, dry area.

1.4 SCHEDULING

A. Schedule installation of items to occur after application of exposed finishes wherever installation will not damage exposed finish surfaces and completion of finishes will not impede installation.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: KI

B. Product: Fixed Sequence Seating

C. "As Equal" products must be approved as meeting specification.

2.2 DESCRIPTION

A. Sequence HD (High Density) Seating features a segmented seamless steel tubular beam with floor- or riser-mounted bases that support individual seats. Automatic flip up (gravity-activated) seats and folding tablets available (3 sizes). Optional power and data access available. Torsion on the Go! arms or Torsion Air arms available when tablet arms are not used; armless version also available. Sloped floors will be accommodated.

B. Beam-mounted flip seats with tablet arms, floor or riser mounted, including but not limited to:
1) Continuous, segmented custom size beams
2) Floor or riser-mounted beams
3) Torsion on the Go! chair with full flex or no flex back or Torsion Air chair with full flex or no flex back
4) One tablet arm with three tablet board options
5) Square Column (Basic) bases
6) Optional power and data module and distribution system
7) Powder-coated steel frames provide maximum durability

2.3 CONSTRUCTION

A. Frames (choose one)
Sequence HD Seating "Basic" rectangular frames with tablet arms, floor-mounted or riser-mounted base plate is 6" x 8", 11-gauge stamped steel flange with 1/2" diameter anchoring holes pierced at each corner. Pedestal column is 11-gauge, 1-1/2" x 2" seamless tubular steel upright welded to the base plate. The vertical column on the floor-mounted base extends down through the base plate and welded around the vertical column at the pierced opening in the base. For added strength, a steel strap is welded across the bottom of the vertical column and welded to the bottom of the floor flange. The vertical column is capped with a stamped steel yoke cover to support the beam. The stamped steel yoke is welded to the seat spider. Four nuts are welded inside the steel yoke to accept screws from the base assembly to lock the seat and support beam firmly into place. The bases are positioned directly under the center of the seat. The seats are joined in sequence along an 11-gauge, 1-1/2" x 2" seamless steel tubular beam cradled in the yokes on top of the bases. No holes are required to be drilled in the horizontal sequence beam to enable the seats to be positioned on the bases at any point along the beam. Sequence HD beams are furnished in any length with beam segments joined inside a yoke with beam-ganging plates that lock the two segments of the beam together. Seat frame is made of 1" square, 13-gauge steel tubing welded to the back-flex mechanism tube. The seat frame is supported by, and welded to, the beam-mounting yoke, made of 11-gauge steel. Seats not located directly above a base are fastened with a yoke only. Plastic flange covers are furnished on the floor-mounted bases only; not available on riser-mounted bases and sloped bases when power is specified. Beams can be concave or convex radiused to match the room requirements. Floor flanges can be furnished at specific angles to adapt to sloped floor requirements.

B. HD Tablet Arms (choose one)
The tablet support consists of 1" x 2" rectangular, 14-gauge steel tubing. The support is welded to the beam-mounting yoke, made of 11-gauge steel. The tablet mechanism is a self-storing, one-motion mechanism. The mechanism consists of a pivot arm, pivot mount bracket, and support bracket constructed of

7-gauge steel with controlled 90° up-and-down rotation. The tablet arm stores underneath the seat at a vertical angle, without interfering with the seat.

The tablet board is made from 13 ply, 18mm Baltic birch plywood, sanded, sealed, and lacquered on all edges. The writing surface is .040" thick high pressure laminate. The backing is .04" thick phenolic backing sheet. Three tablet sizes are available:

- Small (7.5" x 11.12" x 18.0")
- Medium (8.8" x 13.63" x 19.3")
- Large (11.0" x 15.8" x 21.5")

C. Shells (choose one)

1) Torsion on the Go!
Seat is a two-piece construction of molded plywood upholstery board with a molded compound-curved polypropylene shroud with a textured finish. Seat is always upholstered with 1-3/4" foam applied to the molded plywood upholstery board, upholstered with fabric. Backrest is available in either a poly or upholstered version. The backrest is molded compound-curved polypropylene with a textured finish. The back upholstery liner is molded polypropylene with glued-on ½" foam. Fabric is upholstered over the foam. The liner is secured to the backrest with four #10 color-matched machine screws. The gravity-lift automatic seat return is accomplished by a counterweight, with no springs or mechanical actuators to fatigue or fail. Two .079" thick, 14-gauge welded steel backrest supports attach the backrest to the torsion mechanism. A cast steel bushing is welded onto each backrest support, capturing the Torsion back-flex springs. The back flex is achieved by the torsion mechanism. It consists of two flat torsion springs captured at both ends by steel bushings that are pinned to the backrest supports. The torsion mechanism creates gradually increasing resistance over the full 12° of back flex or approximately 6". The non-flex back option allows less than 1" of back movement.

2) Torsion Air®
Seat is a two-piece construction of molded plywood upholstery board with a molded compound-curved polypropylene shroud with a textured finish. Seat is always upholstered. Foam of 1-3/4" is applied to the molded plywood upholstery board. Fabric is then upholstered over the foam. Backrest frame is molded glass-reinforced nylon. Mesh fabric is of 100% polyester. The gravity-lift automatic seat return is accomplished by a counterweight, with no springs or mechanical actuators to fatigue or fail. Two welded steel backrest supports attach the backrest to the torsion mechanism. The back flex is achieved by the torsion mechanism. It consists of two flat torsion springs captured at both ends by steel bushings that are welded to the backrest supports. The torsion mechanism creates gradually increasing resistance over the full 12° of back flex. The non-flex back option allows less than 1" of back movement.

3) Strive® Nesting
Two-piece injection-molded polypropylene seat and backrest, reinforced with internal steel channels, and assembled using hidden fasteners. The seat is available in a poly or upholstered version. For the upholstered version, molded urethane foam (1" depth) is applied to the seat board. Fabric is then upholstered over the foam using a drawstring process. Note: upholstered seat is required with translucent poly backs.
Backrest is injection-molded polypropylene with integral steel cantilever springs. The combination of the slotted polypropylene back and the spring steel provides a supportive flexing back. Springs are nominal 4.5mm diameter chrome silicon valve spring wire. Backrest is available in a poly version or upholstered. For the upholstered version, molded urethane foam is applied to a back board. Fabric is then upholstered over the foam using a drawstring process. Backrest has an integral, molded "handle". The seat automatically flips up when the user gets up.

D. Optional Power and Data

1) Power/Data Module and Distribution System
Product is designed to bring power and data from the building power source to a position directly below the seat height and between two seats to accommodate the requirements of notebook computers in a temporary use situation. The module will not extend beyond the front of the seats nor interfere with the operation of the tablet arm or cleaning of the floor. All wires will be concealed and enclosed in a plastic wireway. All power/data components are available in black only.

2) Power/Data Module
The power/data module is 8-5/8" tall by 7-7/8" deep by 3-1/2" wide. The module is constructed of molded polycarbonate with a textured finish, meeting UL 94-V0 minimum requirements. The module will have two 15-amp simplex receptacles and two data ports. These ports will accept any of the included data-jack adapter plates, which allow the use of various brands and models of data connectors. The unit will mount to the steel support beam with steel strap and (four) screws. The removable bottom cover will allow access to the wireway and data jacks during and after the installation. The module will attach and provide support for the wireway. The module is available in black only.

3) Wireway
The wireway is constructed of extruded rigid PVC approximately .075" thick by 2-1/8" wide by 3-1/2" tall, meeting UL 94-HB minimum. The interior area of wireway will be approximately 6.6 cubic inches. The wireway includes a 24-gauge, S-shaped metal divider measuring 1-15/16" x 7/8" and is attached to a groove in the wireway. Each end of the wireway will either be supported by a module or contained by 16-gauge steel brackets. These support brackets will also secure a molded polypropylene bellows, which bridges the gap between wireway units. The flexible center to the bellows allows for assembly to straight and radius seating layouts. The wireway is available in black only.

4) 5–Wire Electrical Harness
The 5-wire distribution harness of flexible conduit distributes power between the power/data modules as well as accept a power infeed harness. Each harness consists of a three-way housing on one end and a single plug on the other. The harness(s) will be enclosed in an extruded plastic wireway with a metal divider in the full-length units to separate power and communication or data cables.

5) Power Infeed
The 5-wire power infeed consists of three 12-gauge hot wires, one 12-gauge ground wire, one 10-gauge neutral wire encased in liquid-tight conduit which will be hard wired to the building power source. The infeed will enter the wireway through a 16-gauge steel end cover at either end. Power is fed into the end cover through a ¾" –90 degree elbow being fed by ½" liquid-tight conduit. The wire whip is supplied with 24" of liquid-tight conduit and a 6" lead of wire. It is recommended that the power source be located below the beam, within (+/-) 6 inches from the center <u>between</u> the first and second seat in the row on the end the infeed is located.

6) Data Infeed
The data infeed enclosure (if required) is constructed of extruded rigid PVC approximately 1-5/16" x 2-1/8" with a flexible hinge on one side to allow feeding of data wires. The data wires will enter the wireway through a field-located and created rectangular hole cut in the bottom surface of the wireway. This infeed enclosure will be secured to the floor with a 16-gauge steel bracket. Data infeeds are available in black only.

7) UL Listing
The UL Listing applies to the electrical components only under UL 1286.

E. Accessories

1) Torsion on the Go! Arms
Armrests are made of injection-molded nylon and rotate with the back flex. Torsion on the Go! arms cannot be used with tablet arms.

2) Torsion Air Arms
Armrests are made of polypropylene and rotate with the back flex. Torsion Air arms cannot be used with tablet arms.

3) Beam Arms
Beam arms are injection-molded engineering-grade thermoplastic, 2-5/8" wide by 10-1/8" long and are attached to a 1" x 2", 14-gauge steel rectangular vertical post weldment with two concealed screws. The beam arms are not attached to the seats, and are designed to complement the tablet arm support.

4) Row Markers
Available on beam arms only. Row markers are .78" x 1.18" ellipse, .020" thick lexan film plate, secured with adhesive into a recess within the top surface of the thermoplastic armcap.

2.4 FINISHES

Frame finishes - Powder-coated finish is standard on all frames. Standard KI fabrics available; C.O.M. (customer's own material) fabrics require factory approval. All finishes and colors to be selected by architect. Refer to KI Color Addendum for standard finishes. Custom colors and finishes available; contact factory.

2.5 TEST REQUIREMENTS

"Sequence HD Seating" is designed and manufactured in compliance with the intent of ANSI/BIFMA X5.4-2012. Seating exceeds all applicable BIFMA performance test criteria. Sequence HD Seating power and data components are UL listed under UL1286. Sequence HD Seating is SCS Indoor Air quality Certified.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordination details with other work supporting, adjoining, or otherwise contracting items as required to insure proper installation.

B. Examine construction to verify that:

1) Dimensions are correct to manufacturer's specifications.

C. Do not install items until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install items in strict accordance to manufacturer's Assembly Instructions and approved Shop Drawings.

B. FLOOR MOUNTING REQUIREMENTS

Minimum Floor Construction Required for Upright Installation

1) Concrete Floors
   - 3000 psi concrete compressive strength
   - 3" thick free of obstructions for 1-1/2"
   - 4" thick free of obstructions for 2-1/2" for riser mount
   - Riser to be plumb within 1/8 degree
   - Minimum anchor embedment 1-1/2"
2) Wood Floors
   - Minimum two layers of ¾" thickness tongue & groove
   - APA rated grade plywood
   - Allow minimum embedment 1-1/2" with lag screws

   NOTE: Warranty null and void if KI product is installed on flooring not meeting minimum structural requirements stated above.

   For non-typical floors not listed above, contact KI.
3) Raised-Access Floors
   - Minimum rating of 125 PSF
   - Must be installed with grade 3 or better 3/8" diameter bolt, washers and nuts

Floor Fastener Requirements

1) Concrete Floors
   - 1/4" x 2-5/8" Hilti KH-EZ
   - Max. torque: 18 ft. lbs.
   - Four anchor assemblies required per base

Floor Fastener Requirements (continued)

2) Wood Floors
   - 3/8" x 2-1/2" Hex washer head tapping screw
   - Four bolt assemblies required per base
3) Raised Floors
   a. 3/8-16 x 2-1/2" Grade 3 bolt (2-1/2" minimum length), 3/8" Grade 3 washer (quantity of 2), 3/8" Grade 3 lock washer, 3/8-16 Grade 3 nut
   b. Four bolt assemblies required per base

SECTION 142400 - ELEVATORS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Shop Drawings and Samples of exposed finishes.

1. Submit seismic qualification certificates for elevator equipment.
2. Submit operation and maintenance data to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Thyssen Krupp Endura Elevator, Machine Room Less

B. Basis-of-Design Product: 3500 LB, center door, elevator or a comparable product of one of the following:

1. American Crescent Elevator Mfg., Corp.
2. Fujitec America, Inc.
3. Minnesota Elevator, Inc.
4. Mowrey Elevator Co.
5. Otis Elevator Co.
6. Schindler Elevator Corp.
7. Schumacher Elevator Co.
8. Thyssen -Krupp

2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.

1. See Structural Drawings/Specifications for design earthquake spectral response acceleration short period (Sds) criteria.
2. Project Seismic Design Category: D.
3. Elevator Importance Factor: 1.0.

2.3 ELEVATORS

A. Endura unit by Thyssen Krupp

B. Power Unit: EP260 50 HP

C. Rated Load: 3500 lb

D. Rated Speed: 150 fpm (0.38 or 0.41 m/s).

E. Operation System: TAC32

F. Auxiliary Operations: In addition to primary operation control, provide standby power operation, and battery-powered lowering.

G. Inside Car Width: Varies with size.

H. Inside Depth: Varies with size.

I. Inside Height: 7’-11 cab height to underside of ceiling.

2.4 SYSTEMS AND COMPONENTS

A. Furnish required concrete and masonry inserts. Installation is specified in other Specification Sections.

B. Provide protective PVC or HDPE pipe casings complying with ASME A17.1/CSA B44 for in-ground cylinders.

C. Door Reopening Devices, Infrared Array: Uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams causes doors to stop and reopen.

2.5 CAR ENCLOSURES AND ENTRANCES

A. Car Enclosures: Provide enameled-steel car enclosures to receive removable wall panels, with car roof, access doors, power door operators, and ventilation. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

1. Floor finish to match corridor finish.
2. Wall Panels: Laminate wall panels.
3. Front Walls (Return Panels): Satin stainless-steel, No. 4 finish.
4. Doors Faces: Satin stainless-steel, No. 4 finish.
5. Sills: Extruded aluminum, with grooved surface, 1/4-inch (6.4-mm) thickness.
6. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
7. Ceiling: Satin stainless-steel, No. 4 finish flush panels, with four low-voltage downlights in each panel.
8. Handrails: Manufacturer's standard stainless-steel handrails on both sides of car.

B. Hoistway Entrances: Manufacturer's standard hollow-metal, sliding, door-and-frame entrances.

1. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.
2. Frames: Satin stainless-steel, No. 4 finish.
3. Doors Faces: Matching car doors.
4. Sills: Matching car sills.

2.6 SIGNAL EQUIPMENT

A. Illuminated hall-call and car-call buttons.

B. Except for buttons and illuminated elements, fabricate car and hall fixtures from satin stainless-steel, No. 4 finish.

C. Manufacturer's standard car control station in each car. Mount in return panel adjacent to car door unless otherwise indicated.

1. Mount controls to comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

D. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

E. Car position indicator above the car door or above the car control station. Also provide audible signal to indicate that car is either stopping at or passing the floor. Include direction arrows if not provided in car control station.

F. Hall Push-Button Stations: Provide one hall push-button station at each landing.

G. Hall lanterns with illuminated arrows.

1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
2. Units mounted in both jambs of entrance frame.
3. Units mounted in both car door jambs.

H. Hall Annunciator: With each lantern, provide audible signals. At manufacturer's option, audible signal may be placed on car.

I. Hall position indicator above each hoistway entrance at ground floor.

J. Corridor Call Station Pictograph Signs: Provide signs with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.7 FINISH MATERIALS

A. Steel Sheet: Cold-rolled steel sheet, ASTM A 1008/A 1008M, exposed, matte finish, except that hot-rolled steel sheet, ASTM A 1011/A 1011M may be used for door frames.

B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

C. Stainless-Steel Bars: ASTM A 276, Type 304.

D. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.

E. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install per manufacturers recommendations.

B. Install piping above the floor, where possible. Where not possible, install underground piping in Schedule 40 PVC pipe casing assembled with solvent-cemented fittings.

C. Adjust elevators for 1/4-inch (6-mm) leveling tolerance.

D. Set sills flush with finished floor. Fill space under sills solidly with nonshrink, nonmetallic grout.

E. On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

3.2 MAINTENANCE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide one year's full maintenance service. Include monthly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting.

END OF SECTION 142400

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Supports and anchorages.

B. Related Sections:

1. Division 01 31 00 Section Project Management and Coordination for requirements related to each sub contractor's responsibility to complete coordination drawings and submit.
2. Division 01 78 39 Section Project Record Documents for requirements related to each sub contractor's responsibility to submit record drawing to the owner as part of the operation and maintenance data (section 017823).
3. Division 21 Section "Fire-Suppression Standpipes" for standpipe piping.
4. Division 21 Section "Sprinkler Systems" for related requirements and sprinkler piping.

1.2 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.

1.3 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 Fire-Suppression 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.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21 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.

2.2 JOINING MATERIALS

A. Refer to individual Division 21 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, 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 or BAg1, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12.

G. Solvent Cements for Joining CPVC Plastic Piping: ASTM F 493.

2.3 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Plastic. Include two for each sealing element.

D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 GROUT

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. 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.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.5 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, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

   1. Finish: Polished chrome-plated and rough brass.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated and rough brass.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS-COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 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.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. 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.

O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals, Link-Seal model “Century-Line CS”, color blue or prior approved equal. Select sleeve size to allow for 1-inch 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.

P. 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.

Q. Verify final equipment locations for roughing-in.

R. 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 21 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.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

L. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

M. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

N. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

O. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

P. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 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 fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor fire-suppression 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.

3.5 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.6 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Permanent sleeves are not required for holes formed by removable PE sleeves.

D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

E. Install sleeves in new partitions, slabs, and walls as they are built.

F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.

I. Seal space outside of sleeves in concrete slabs and walls with grout.

J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

K. Install sleeve materials according to the following applications:

1. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE.
2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.

   a. Extend sleeves 2 inches above finished floor level.
   b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing and Trim."

3. Sleeves for Piping Passing through Gypsum-Board Partitions:

   a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
   b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
   c. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.

4. Sleeves for Piping Passing through Concrete Roof Slabs: Galvanized-steel pipe.
5. Sleeves for Piping Passing through Exterior Concrete Walls:

   a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
   b. Cast-iron wall-pipe sleeves for pipes NPS 6 and larger.
   c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.

6. Sleeves for Piping Passing through Interior Concrete Walls:

   a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
   b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping."

3.7 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.

4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
5. Bare Piping in Equipment Rooms: One piece, cast brass.
6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

END OF SECTION 210500

SECTION 210529 – SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and equipment hangers, supports, and associated anchors.

1.2 RELATED SECTIONS

A. Section 21 05 49 - Vibration Isolation.

B. Section 21 12 23 – Fire Protection Valves.

C. Section 21 23 00 - Wet Pipe Sprinkler System.

1.3 REFERENCES

A. ASME B31.1 - Power Piping.

B. NFPA 13 - Standard for the Installation of Sprinkler Systems.

C. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

D. Provide pipe hangers and supports of materials, design, and manufacture which comply with MSS SP-58.

E. Select and apply pipe hangers and supports, complying with MSS SP-69.

F. Fabricate and install pipe hangers and supports, complying with MSS SP-89.

1.4 QUALITY ASSURANCE

A. Supports for Sprinkler Piping: In conformance with NFPA 13, UL listed.

B. Supports for Standpipes: In conformance with NFPA 14, UL listed.

1.5 SUBMITTALS

A. Submit product data under provisions of Division 1.

B. Indicate hanger and support framing and attachment methods.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS – ACCEPTABLE MANUFACTURERS

A. PHD Mfg. Co.

B. Michigan Hanger.

C. Grinnell.

D. Empire.

E. Pipe Shields, Incorporated.

F. B-Line.

2.2 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 Inch to 1 1/2 Inches: Carbon steel, adjustable band hanger, MSS Type 7.

B. Hangers for Pipe Sizes 2 Inches to 4 Inches and Pipe Sizes 6 Inches and Over: Carbon steel, adjustable, clevis, MSS Type 1.

C. Hangers for Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, MSS Type 43.

D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods; cast iron roll and stand for pipe sizes 6 inches and over.

E. Wall Support for Pipe Sizes to 2 Inches: Cast iron bracket, MSS SP-69 Type 34.

F. Wall Support for Pipe Sizes 3 Inches and Over: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll for pipe sizes 6 inches and over, MSS Type 33.

G. Vertical Support: Steel riser clamp, MSS Type 8.

H. Floor Support for all Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support, MSS Type 37.

I. Floor Support for Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support, MSS Type 46.

J. Copper Pipe Support: Carbon steel ring, adjustable copper plated, MSS Type 7.

2.3 HANGER RODS

A. Steel Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

2.4 INSERTS

A. Inserts: Malleable iron case and plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods, MSS Type 18.

2.5 FINISH

A. Paint pipe hangers and supports with a prime coat of corrosion resistant paint.

B. Provide copper plated hangers and supports for copper piping.

PART 3 - EXECUTION

3.1 INSERTS

A. Furnish inserts to Section 03 30 00 for placement in concrete formwork.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

D. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.2 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as follows:

Pipe Size	Max. Hanger Size	Hanger Rod Diameter
1/2 to 1 1/2 inch	6'-0"	3/8"
2 inches	10'-0"	3/8"
2 1/2 to 3 inches	10'-0"	1/2"
4 to 6 inches	10'-0"	5/8"
8 to 12 inches	12'-0"	7/8"
14 Inches and Over	12'-0"	1"
PVC (All Sizes)	(Per Manufacturer's Recommendations and Indiana Code)	

B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place a hanger within 12 inches of each horizontal elbow.

D. Use hangers with 1 1/2 inch minimum vertical adjustment.

E. Cast iron soil pipe shall be supported at not more than 5 foot intervals, except that pipe exceeding 5 feet in length, shall be supported at not more than 10 foot intervals. Supports shall be adequate to maintain alignment and prevent sagging and shall be placed within 18 inches of the hub or joint. Hubless or compression gasket joints must be supported on both sides of every joint.

F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Support overhead piping by means of hangers which are capable of screw adjusting after erection of the pipe. Note that all horizontal piping in Equipment Rooms, etc. shall be supported on vibration hangers as specified under Section 21 05 49. Do not support piping from metal roof deck under any circumstances.

J. Where overhead ducts or breeching run between pipes and the ceiling, suspend a 3 inch angle iron trapeze on rods from inserts in clear of the duct and then suspend individual pipe hangers from the angle iron. Size rods as required for the size and quantity of pipes to be supported. Use 3/8 inch minimum rod size.

K. Where there is more than one run of pipe along a wall, tier the pipes one above the other close to the wall. Where there is expansion or contraction, use double rod hangers with roller supports. Use pipe roll hangers of a type which will not loosen or fall apart under vibration. Use cast iron rolls shaped to fit the pipe.

L. Support piping in tunnels from steel pipe support racks and/or inserts placed in the tunnel ceiling by this Contractor. Place piping to allow maximum access to all Tunnel Areas, Equipment Rooms, etc. Consult with the Architect's representative before any pipes or support racks are installed.

M. For piping suspended from unit slab construction, extend piping support rods through the unit slab with a 12 inch by 12 inch by 1/4 inch plate washer on top of the slab.

N. In general, concentrated or other loads shall not be suspended directly from the bottom of wood structural members, unless approved by the Architect. Loads suspended from open web joists or trusses may be transferred to the bottom chord of the structural member of the panel joints. Loads suspended from solid web joists shall be transferred to the joists only through the top flange or web. All suspension systems shall be only as approved by the Architect.

O. Where pipe vibration is transmitted to building structure or attached equipment, provide hangers supplemented by spring cushions or an energy absorbing means in the supports themselves or through the addition of flexible piping connectors or other auxiliary equipment. See Sections 21 05 49.

END OF SECTION 210529

SECTION 210548 – VIBRATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Restraining braces.

1.2 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

Basis-of-Design Product: Subject to compliance with requirements, provide or a comparable product by one of the following:
1. Kinetics Noise Control.
2. Mason Industries.
3. Vibration Mountings & Controls, Inc

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 neoprene.

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.

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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

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.

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 DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127 and NFPA 13.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

E. 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.

F. 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.

G. 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 pre stressed 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.

END OF SECTION 210548

SECTION 210553 – IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.

1.2 QUALITY ASSURANCE

A. Signs: Refer to NFPA 13-24.4 "Hydraulic Design Information Signs." and NFPA 24.6 “General Information Sign” for project close-out labeling

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. 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 high.

E. Pipe Label Color Schedule:

1. Fire Protection Piping:

a. Background Color: White.
b. Letter Color: Red.

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.

PART 4 - EXECUTION

4.1 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.

4.2 PIPE LABEL INSTALLATION

A. 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.

END OF SECTION 210553

SECTION 211313 – SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinkler specialty pipe fittings.
5. Sprinklers.
6. Excess-pressure pumps.
7. Alarm devices.
8. Pressure gages.

B. Related Sections:

1. Division 21 Section “Common Work Results For Fire Suppression”.
2. Division 21 Section "Fire-Suppression Standpipes" for standpipe piping.

1.2 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated in related specification section.

B. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.

1. Provide dry sprinkler heads in locations that have potential of freezing: soffit above drive thru to parking, at overhead garage doors, vestibule, etc.
2. Open web truss space at roof shall be provided with Dry-pipe system automatic sprinklers.

C. Open web truss space on each floor shall be provided with automatic sprinklers.

1.3 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Coordinate with local authorities and perform fire-hydrant flow test.

C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Determine Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications: See architectural for specific classification, NFPA for recommended hazard classifications and coordinate with local fire marshal for additional local requirements and classifications.

1.4 SUBMITTALS

A. This contractor shall obtain approved shop drawings from Engineer and Architect and incorporate comments and changes prior to fabrication and installation of fire sprinkler system. Any costs created from field changes or corrections due to not incorporating Engineer and Architect comments shall be the responsibility of this contractor.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For wet-pipe & dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

D. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.

F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping.", submit with Operation and Maintenance Manual

G. Operation and maintenance data.

H. Provide as-built drawings, submit with Operation and Maintenance Manual.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume

engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

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. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Schedule 30, Black-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.

B. Thinwall Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.

C. Schedule 5 Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, lightwall, with plain ends.

D. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

E. Uncoated, Steel Couplings: ASTM A 865, threaded.

F. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

G. Malleable- or Ductile-Iron Unions: UL 860.

H. Cast-Iron Flanges: ASME 16.1, Class 125.

I. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

J. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Corcoran Piping System Co.
   b. National Fittings, Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.

2. Pressure Rating: 175 psig minimum.
3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

K. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

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. Victaulic Company.

2.3 CPVC PIPE AND FITTINGS

A. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings. As allowed by NFPA.

B. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.

1. Use CPVC solvent cement that has a VOC content of 490 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).

C. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating: 175 psig.

B. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   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. Globe Fire Sprinkler Corporation.
   e. Milwaukee Valve Company.
   f. Mueller Co.; Water Products Division.
   g. NIBCO INC.
   h. Reliable Automatic Sprinkler Co., Inc.
   i. Tyco Fire & Building Products LP.
   j. Victaulic Company.
   k. Viking Corporation.
   l. Watts Water Technologies, Inc.

2. Standard: UL 312.
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

C. Bronze OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. Milwaukee Valve Company.
   d. NIBCO INC.
   e. United Brass Works, Inc.

2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

D. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   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. Milwaukee Valve Company.
e. Mueller Co.; Water Products Division.
f. NIBCO INC.
g. Tyco Fire & Building Products LP.
h. United Brass Works, Inc.
i. Watts Water Technologies, Inc.

2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

E. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

a. Global Safety Products, Inc.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. Tyco Fire & Building Products LP.
e. Victaulic Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:

a. Valve Type: Ball or butterfly.
b. Body Material: Bronze.
c. End Connections: Threaded.

5. Valves NPS 2-1/2 and Larger:

a. Valve Type: Butterfly.
b. Body Material: Cast or ductile iron.
c. End Connections: Flanged, grooved, or wafer.

6. Valve Operation: Integral electrical, 115-V ac, prewired, supervisory switch or visual indicating device.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Minimum Pressure Rating: 175 psig.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements)::

   a. Milwaukee Valve Company.
   b. NIBCO INC.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
   e. Watts Water Technologies, Inc.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Minimum Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.

2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkle alarm switch, pressure gauge and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.

2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.

4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

D. Dry-Pipe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements)::

   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.

2. Standard: UL 260
3. Design: Differential-pressure type.
4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
5. Air Compressor:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):
      1) Gast Manufacturing Inc.
      2) General Air Products, Inc.
      3) Viking Corporation.

   b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   c. Motor Horsepower: Fractional.
   d. Power: 120-V ac, 60 Hz, single phase.

2.7 FIRE-DEPARTMENT CONNECTIONS

A. Flush-Type, Fire-Department Connection:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkhard #166 or comparable product by one of the following: Verify inlet quantity with local fire marshal, verify finish with architect (Substitutions: See Section 016000 – Product Requirements):

   a. Elkhart Brass Mfg. Company, Inc.
   b. Guardian Fire Equipment, Inc.
   c. Potter Roemer.

2. Standard: UL 405.
3. Type: Flush, for wall mounting.
4. Pressure Rating: 175 psig minimum.

5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Body Style: Horizontal.
11. Number of Inlets: Two.
12. Outlet Location: Bottom or Top. Verify location with application.
1. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
2. Finish: Polished brass.
3. Outlet Size: NPS 4.

B. Location: Shall be on the address side of the building, or where directed by the local authorities.

2.8 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements)::

   a. Tyco Fire & Building Products LP.
   b. Victaulic Company.

2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Tyco Fire & Building Products LP.
   b. Victaulic Company.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.

4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Elkhart Brass Mfg. Company, Inc.
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.

2. Standard: UL 199.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Tyco Fire & Building Products LP.
   b. Victaulic Company.
   c. Viking Corporation.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. CECA, LLC.
   b. Corcoran Piping System Co.
   c. Merit Manufacturing; a division of Anvil International, Inc.

2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum.

4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

F. Flexible, Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Fivalco Inc.
   b. FlexHead Industries, Inc.
   c. Gateway Tubing, Inc.

2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175 psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.9 SPRINKLERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):
2. Tyco Fire & Building Products LP.
3. Victaulic Company.
4. Viking Corporation.
5. Reliable Automatic Sprinkler Co., Inc.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory," listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Residential Applications: UL 1626.
4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Chrome plated.
2. Match ceiling color, all areas that have ceiling painted non-white.
3. White
4. Bronze.
5. Corrosion-resistant paint.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mount (semi-recessed): White steel, one piece.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
3. Ceiling Mounting (Concealed Heads): Verify custom color with Architect in areas where ceiling are painted non-white.

F. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. McMaster-Carr (or approved equal); model 6411T25 red in color.
   b. Swift Fire Protection Inc. (or approved equal); model ACGH2RO50 red in color.

2. Standard: UL 199.
3. Type: Heavy duty 2 piece wire cage with screw fastening device for attaching to sprinkler head.

2.10 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Victaulic Company.
   b. Viking Corporation.

2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: 10-inch diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
7. Inlet: NPS 3/4.
8. Outlet: NPS 1 drain connection.

C. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. ADT Security Services, Inc.
   b. McDonnell & Miller; ITT Industries.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.
   e. Viking Corporation.
   f. Watts Industries (Canada) Inc.

2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.

2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.11 HORN AND LIGHT

A. Provide a combination horn and light alarm with 100-decibel vibratory horn and a 40-watt flashing light. Unit shall be similar to Farr-Larm as manufactured by Fire-Trols. Substitutions: See Section 016000 – Product Requirements.

2.12 PRESSURE GAGES

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Require-

ments):
2. AMETEK; U.S. Gauge Division.
3. Ashcroft, Inc.
4. Brecco Corporation.
5. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 250 psig minimum.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

M. Fill sprinkler system piping with water.

N. Drain dry-pipe sprinkler piping.

O. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices and air compressors.

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

3.4 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow,

in main supply to system.

2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.
3. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

   a. Install air compressor and compressed-air supply piping.

3.5 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing such as vestibules or other areas with direct opening to the outdoors.

C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.6 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire-department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.7 INSTALLATION OF HORN AND LIGHT

A. Furnish specified items to the Electrical Contractor. Electrical Contractor shall mount both items and provide all electrical devices; conduit and wiring required.

3.8 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems 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. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run excess-pressure pumps.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.11 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Standard-weight or Schedule 30, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
4. Standard-weight or Schedule 30, galvanized-steel pipe with plain ends; galvanized, plain-end-pipe fittings; and twist-locked joints.
5. Standard-weight or Schedule 30, black-steel pipe with cut-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
6. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

7. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
8. Thinwall black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
9. Thinwall black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
10. Thinwall black-steel pipe with plain ends; welding fittings; and welded joints.
11. Schedule 5 steel pipe; steel pressure-seal fittings; and pressure-sealed joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 6, shall be one of the following:

1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Standard-weight or Schedule 30, black-steel pipe with cut-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
6. Thinwall black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. Thinwall black-steel pipe with plain ends; welding fittings; and welded joints.

E. Dry-pipe sprinkler system, NPS 2 and smaller , shall be one of the following:

1. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
2. Standard-weight Schedule 30 or thinwall, galvanized-steel pipe with plain ends; plain-end-pipe fittings; and twist-locked joints.
3. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. CPVC and Schedule 10 piping as allowed per NFPA.

F. Dry-pipe sprinkler system, NPS 2-1/2 to NPS 6, shall be one of the following:

1. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
2. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. CPVC and Schedule 10 piping as allowed per NFPA.

3.12 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Semi-recessed sprinklers.
3. Rooms with Gyp board Ceilings: Fully-recessed sprinklers.
4. Wall Mounting: Sidewall sprinklers.
5. Spaces Subject to Freezing: Sidewall, dry sprinklers; all vestibules
6. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Semi-recessed Sprinklers: White, with white escutcheon.
2. Fully-recessed Sprinklers: To match ceiling color, provide color chart to Architect for selection.
3. Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Temporary water service during construction.
8. Equipment installation requirements common to equipment sections.
9. Concrete bases.
10. Supports and anchorages.

B. Related Sections:

1. Division 01 Section Project Management and Coordination for requirements related to each sub contractor's responsibility to complete coordination drawings and submit.
2. Division 01 78 39 Section Project Record Documents for requirements related to each sub contractor's responsibility to submit record drawing to the owner as part of the operation and maintenance data (section 017823).
3. Division 230500-1.3 coordination.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than plumbing 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 plumbing 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.

1.3 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.

PART 2 - PRODUCTS

2.1 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.

2.2 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, 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 or BAg1, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12.

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.

2.3 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 Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Plastic Carbon steel Stainless steel. Include two for each sealing element.

D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. 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.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 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, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated and rough brass.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated and rough brass.

2.7 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, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 TEMPORARY WATER SERVICE

A. Provide a metered, domestic water connection for site use following the installation of the water main.

B. Repair leaks for a water tight installation.

C. Protect water service from freezing conditions using electrical heat tape or other means.

D. Install at least one valved hose connection for use by all personnel on site.

E. Comply with municipal requirements regarding water service and usage.

3.2 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. Verify final equipment locations for roughing-in.

M. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 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.

3.6 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 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 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 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "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 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing 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.

3.9 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.

3.10 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.11 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Permanent sleeves are not required for holes formed by removable PE sleeves.

D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

E. Install sleeves in new partitions, slabs, and walls as they are built.

F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.

I. Seal space outside of sleeves in concrete slabs and walls with grout.

J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

K. Install sleeve materials according to the following applications:

1. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE.
2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.

   a. Extend sleeves 2 inches above finished floor level.
   b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing and Trim."

3. Sleeves for Piping Passing through Gypsum-Board Partitions:

   a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
   b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
   c. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.

4. Sleeves for Piping Passing through Concrete Roof Slabs: Galvanized-steel pipe.

5. Sleeves for Piping Passing through Exterior Concrete Walls:

   a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
   b. Cast-iron wall-pipe sleeves for pipes NPS 6 and larger.
   c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.

6. Sleeves for Piping Passing through Interior Concrete Walls:

   a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
   b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping."

3.12 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
5. Bare Piping in Equipment Rooms: One piece, cast brass.
6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

END OF SECTION 220500

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze swing check valves.
5. Iron swing check valves.
6. Iron swing check valves with closure control.
7. Bronze gate valves.
8. Iron gate valves.
9. Bronze globe valves.
10. Iron globe valves.
11. Chainwheels.

B. Related Sections:

1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
2. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.
3. Section 221319 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.
4. Section 221423 "Storm Drainage Piping Specialties" for valves applicable only to this piping.

1.2 QUALITY ASSURANCE

A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

B. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Product data.

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 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller.
4. 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 stem extensions and the following features:

1. Gate Valves: With rising stem.
2. 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.
3. Butterfly Valves: With extended neck.

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.

2.2 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
d. Hammond Valve.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corporation.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

a. American Valve, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Red-White Valve Corporation.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Require-

ments):

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Division.
f. DeZurik Water Controls.
g. Flo Fab Inc.
h. Hammond Valve.
i. Kitz Corporation.
j. Milwaukee Valve Company.
k. NIBCO INC.
l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Division.
f. DeZurik Water Controls.
g. Flo Fab Inc.
h. Hammond Valve.
i. Kitz Corporation.
j. Milwaukee Valve Company.
k. NIBCO INC.
l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated

pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze.

2.5 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 (Substitutions: See Section 016000 – Product Requirements):

   a. American Valve, Inc.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Hammond Valve.
   f. Kitz Corporation.
   g. Milwaukee Valve Company.
   h. NIBCO INC.
   i. Powell Valves.
   j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded.
   f. Disc: Bronze.

2.6 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements)::

   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. Kitz Corporation.
   f. Milwaukee Valve Company.
   g. NIBCO INC.

h. Powell Valves.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-71, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Gasket: Asbestos free.

2.7 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

a. NIBCO INC.

2. Description:

a. Standard: MSS SP-71, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Gasket: Asbestos free.
h. Closure Control: Factory-installed, exterior lever and spring.

B. Class 125, Iron Swing Check Valves with Lever- and Weight-Closure Control:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

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. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-71, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Gasket: Asbestos free.
h. Closure Control: Factory-installed, exterior lever and weight.

2.8 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements)::

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.

e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.

d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
k. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

2.9 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

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. Flo Fab Inc.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements)::

   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. Flo Fab Inc.
   e. Hammond Valve.
   f. Kitz Corporation.
   g. Milwaukee Valve Company.
   h. NIBCO INC.
   i. Powell Valves.
   j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-70, Type I.
   b. CWP Rating: 200 psig
   c. Body Material: ASTM A 126, gray iron with bolted bonnet.
   d. Ends: Flanged.
   e. Trim: Bronze.
   f. Disc: Solid wedge.
   g. Packing and Gasket: Asbestos free.

2.10 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

   1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
   2. Attachment: For connection to butterfly valve stems.
   3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc coating.
   4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 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 chainwheels on operators for butterfly valves NPS 4 and larger and more than

84 inches above floor. Extend chains to 60 inches above finished floor.

1. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.2 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.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, or butterfly valves.
2. Throttling Service: Ball, or butterfly valves.
3. Pump-Discharge Check Valves:

   a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.

   b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring.

   c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 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: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and brass: May be provided with solder-joint ends instead of threaded ends.

2. Ball Valves: Two piece, full port, bronze with bonze and brass trim.
3. Bronze Swing Check Valves: bronze.

B. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
2. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
3. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.

END OF SECTION 220523

SECTION 220529 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.
6. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

A. 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 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.

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. Coatings, where designated:

   a. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
   b. Nonmetallic Coatings: Plastic coating, jacket, or liner.

3. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon 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. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium
silicate with 100-psig ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 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 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 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.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 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, 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. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. 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.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation 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.

3.5 PAINTING

A. 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.

B. 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 on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use padded hangers for piping that is subject to scratching.

G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. 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.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers

NPS 3/4 to NPS 24.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

J. 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 for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

K. 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. 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.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.

8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

L. 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.

M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll

hanger with springs.

3. 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.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

P. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each product indicated.
2. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
3. Welding certificates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: B.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.

   a. Component Importance Factor: 1.25.
   b. Component Response Modification Factor: 2.5.
   c. Component Amplification Factor: 2.5.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 30%.
4. Design Spectral Response Acceleration at 1-Second Period: 10%.

2.2 VIBRATION ISOLATORS

A. 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 neoprene.

B. 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.

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.

C. Spring Isolators: 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 thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

D. Elastomeric Hangers: 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.

E. Spring Hangers: 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.

2.3 SEISMIC-RESTRAINT DEVICES

A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

B. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

C. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

PART 3 - EXECUTION

3.1 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches.
2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. 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.

G. 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. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Remove and replace malfunctioning units and retest as specified above.

C. Prepare test and inspection reports.

3.3 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 active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 220548

SECTION 220553 – IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.

8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 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, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. 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 high.

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.

C. Coordinate installation of identifying devices with locations of access panels and doors.

3.3 PIPE LABEL INSTALLATION

A. 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. Radon vent piping reduce intervals to 10 feet.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels. B.

B. Pipe Label Color Schedule:

1. Domestic Water Piping:

   a. Background Color: White.
   b. Letter Color: Black.

2. Sanitary Waste, Vent and Storm Drainage Piping:

   a. Background Color: White.
   b. Letter Color: Green.

3. Fire Protection

   a. Background Color: White.
   b. Letter Color: Red.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated.
2. For adhesives and sealants, documentation including printed statement of VOC content and chemical components.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less according to ASTM E 84.

B. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less according to ASTM E 84.

2.2 INSULATION MATERIALS

A. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

B. 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.

C. Mineral-Fiber Blanket Insulation: Comply with ASTM C 553, Type II and ASTM C 1290, Type I.

D. Mineral-Fiber, Preformed Pipe Insulation: Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ.

E. Mineral-Fiber, Pipe and Tank Insulation: Complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB; and having factory-applied ASJ. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less.

2.3 ADHESIVES

A. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less.

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less.

2.4 MASTICS

A. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

B. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less.

B. ASJ Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less.

2.6 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.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. 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. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

PART 3 - EXECUTION

3.1 PIPE INSULATION INSTALLATION

A. Comply with requirements of the Midwest Insulation Contractors Association's "National Commercial & Industrial Insulation Standards" for insulation installation on pipes and equipment.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall, Partition, and Floor Penetrations: Install insulation continuously through penetrations. Seal penetrations. Comply with requirements in Section 078413 "Penetration Firestopping."

D. Flexible Elastomeric Insulation Installation:

1. Seal longitudinal seams and end joints with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
2. Insulation Installation on Pipe Fittings and Elbows: Install mitered sections of pipe insulation. Secure insulation materials and seal seams with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

E. Mineral-Fiber Insulation Installation:

1. Insulation Installation on Straight Pipes and Tubes: Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
2. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
3. 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.

F. Interior Piping System Applications: Insulate the following piping systems:

1. Domestic hot water.
2. Recirculated domestic hot water.
3. Roof drain bodies and horizontal rainwater leaders of storm water piping.
4. Exposed water supplies and sanitary drains of fixtures for people with disabilities.

G. Do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.
2. Sanitary drainage and vent piping.
3. Drainage piping located in crawlspaces unless otherwise indicated.
4. Chrome-plated pipes and fittings, except for plumbing fixtures for people with disabilities.
5. Piping specialties, including air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.2 INDOOR PIPING INSULATION SCHEDULE

A. Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawlspaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

B. Domestic Cold Water:

1. **NPS 1** and Smaller: Insulation shall be one of the following:

a. Flexible Elastomeric: **1/2 inch** thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1/2 inch** thick.
c. Polyolefin: **1/2 inch** thick.

2. **NPS 1-1/4** and Larger: Insulation shall be one of the following:

a. Flexible Elastomeric: **1 inch** thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch** thick.
c. Polyolefin: **1 inch** thick.

C. Domestic Hot and Recirculated Hot Water:

1. **NPS 1-1/4** and Smaller: Insulation shall be one of the following:

a. Flexible Elastomeric: **1 inch** thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch** thick.
c. Polyolefin: **1 inch** thick.

2. **NPS 1-1/2** and Larger: Insulation shall be one of the following:

a. Flexible Elastomeric: **1 inch** thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch** thick.
c. Polyolefin: **1 inch** thick.

END OF SECTION 220700

SECTION 221113 – FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Work Description

1. This Work shall consist of furnishing materials and installing the Water Distribution System in accordance with the Plans and Specifications and in compliance with all Standards and Specifications of the Utility.
2. If there is a discrepancy between these specifications and those of the Utility, the Utility's specifications will govern.

B. Fees

1. All fees for chlorination, inspection, and/or application fees shall be paid by the Contractor.
2. Any meter deposit fees, tap fees or other such fees shall be paid by the Contractor

C. General

1. The Contractor shall provide all labor, materials, equipment and tools necessary for the proper installation of water main pipe of the size, or sizes shown on the Drawings. This will include all mains, fittings and appurtenances necessary for a complete and functional water system.

1.2 JOB CONDITIONS

A. Handling Material into Trench:

1. Use the proper implements, tools, and facilities to provide for the safe and convenient prosecution of the work.
2. Carefully lower all pipe and fittings into the trench piece by piece in such a manner as to prevent damage to materials. Do not dump or drop materials into trench.
3. Unless specifically directed otherwise by the Engineer, not more than 100 feet of trench shall be opened ahead of pipe laying work of any one crew, and not more than 100 feet of open ditch shall be left behind the pipe laying work of any one crew. Watchmen or barricades, lanterns and other such signs and signals as may be necessary to warn the public of the dangers in connection with open trenches, excavation and other obstructions, shall be provided by and at the expense of the Contractor. Conformance to all state highway requirements shall be the responsibility of the Contractor when encroachment on highway right-of-way is necessary.

4. When so required or when directed by the Engineer, only one-half of street crossings and road crossing shall be excavated before placing temporary bridges over the side excavated for the convenience of the traveling public. All backfilled ditches shall be maintained in such a manner that they will offer no hazard to the passage of traffic. The convenience of the traveling public and property owners abutting shall be taken into consideration. All public or private drives shall be taken into consideration and shall be promptly backfilled or bridged at the direction of the Engineer. Excavated materials shall be disposed of to cause the least interference and, in every case, the disposition of materials shall be satisfactory to the Engineer. Trenches in which pipes are to be laid shall be excavated in open cut to the depths shown on the approved plans, cut sheets or as specified by the Engineer.
5. Where conditions exist that may be conducive to slides or cave-ins, proper and adequate sheeting, shoring and bracing shall be installed to provide safe working conditions and to prevent damage to work. Trenches shall be kept free of water during the laying of the pipe and until the pipeline has been backfilled.

1.3 NOTIFICATIONS PRIOR TO SHUT DOWNS

A. The Contractor shall notify the Local Utility and the Engineer no less than forty-eight (48) hours prior to beginning any work or any anticipated main shutdowns. No shutdowns may exceed eight (8) hours in length. Any shutdowns that are expected to exceed eight (8) hours must be submitted to the Local Utility and Engineer, in writing, along with a justification for the extended shutdown. Written approval must be received before proceeding.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials shall be in compliance with the Utility's Inventory Standard. A copy of the current Inventory Standard can be obtained from the Utility. Manufacturers offering products that may be incorporated in the Work are limited to the manufacturers acceptable to the Utility.

2.2 PVC Pipe

A. All public water distribution systems may be constructed with PVC pipe.

B. Polyvinyl Chloride (PVC) Pipe and Tracer Wire Installation – PVC pipe, 3" and smaller, shall conform to commercial standards for HDPE pipe, ASTM D-2837, 200 psi pressure rating; SDR 9 or PVC, ASTM D-2241; SDR 21, 200 psi pressure rating. PVC pipe 4" to 12" shall conform to AWWA C900-81. PVC pipe 14" - 24" shall be "Big Blue" and conform to UNI B 11 standards as manufactured by JM Pipe. All PVC pipe shall have a dimension ratio no greater than 18, with an outside diameter identical to cast iron. Tracer wire shall be a minimum 12 gauge coated copper wire and Installed with all PVC water pipe.

C. All pipe shall be pressure rated for 150 psi and all valves and fittings shall be pressure rated at 350 psi for ductile iron. All fittings shall be factory cement lined and coated. Pipe construction per Section 5.025 will require the use of restrained pipe joints or ball and socket river pipe.

2.3 DUCTILE IRON AND CAST IRON FITTINGS (for use with both PVC pipe and ductile iron pipe)

A. Mechanical-joint ductile-iron fittings shall be produced in strict accordance with all applicable terms and provisions of AWWA Specification C153 (ductile-iron compact fittings) of dimension equal to the pipe outside the diameter. The working pressure rating shall be 350 pounds per square inch.

B. All fittings shall be cement-lined and seal-coated, as per AWWA Specification C104, with rubber gaskets conforming to AWWA Specification C111. The exterior of all fittings shall be coated with a bituminous coating as per AWWA Specification C110. All fittings shall be mechanical-joint and furnished with mechanical-joint accessories, including bolts, glands, nuts, etcetera. The glands shall be made of ductile iron. The bolts and nuts shall be made of cast iron (Corten or equal.)

2.4 DUCTILE IRON PIPE

A. Ductile-iron pipe shall be Class 50 ductile-iron pipe conforming to ANSI/AWWA Specification C151/A-21.51. The ductile-iron pipe fittings shall be cement-lined and seal-coated as per AWWA Specification C104 with rubber gaskets conforming to AWWA Specification C111. The exterior of all fittings shall be coated with a bituminous coating as per AWWA Specification C110.

B. The ductile-iron pipe shall be a mechanical-joint or push-on type as specified on the Drawings. The pipe shall be furnished with mechanical-joint accessories, including bolts and nuts which shall be made of cast iron (Corten or equal). Couplings shall be made of an iron-body sleeve, assembly-fabricated, to match the outside diameter of the pipes to be joined. Sleeves shall comply with ASTM Specification A126, Class B, gray iron. Followers shall comply with ASTM Specification A47, Grade 32510 or ASTM Specification A536 ductile iron. The Gasket shall be made of rubber in conformance with AWWA Specification C111.

2.5 COPPER PIPE

A. Copper pipe shall be made of Type "K" copper in conformance with ASTM Specification B88.

2.6 JOINTS

A. Mechanical-joint ductile-iron pipe shall have stuffing-box-type joints complying with ANSI Specification A-21.11 as modified by ANSI Specification A-21.51 for ductile-iron pipe. Slip-joint pipe shall have push-on-type joints (such as tyton, fastite or bell

tite). Use flared-end or compression joints on all copper-pipe connections and fittings.

2.7 RESTRAINING DEVICES

A. Mechanical-joint restraint shall be incorporated on all mechanical-joint fittings and slip-joint pipe where indicated by the Plans. Restraints for 1 6" through 12" ductile-iron pipe shall consist of specially modified push-on joints with joint restraint provided by ductile-iron retainer glands, jointed together by corrosion-resistant, low-alloy, high-strength steel, tee-head bolts, and nuts or set screws. Glands shall be manufactured of ductile iron conforming to ASTM Specification A536-80. The retainer glands shall be interchangeable with the standard glands. The bell retainer ring shall be seated in a groove in the outside diameter of the pipe bell. The spigot retainer ring shall be held on the pipe spigot by a steel retainer gland as detailed on the Plans. Retainer glands on the push-on joint centrifugal pipe shall be capable of rotation to facilitate aligning bolt holes during assembly. The bell retainer gland or ring, and spigot retainer gland or ring on fittings, shall be cast integral with the fitting. The restrained push-on joints for the pipe and its fittings shall be designed for a maximum water working pressure of the metric equivalent to 250 pounds per square inch. The push-on joints with joint restraint shall be capable of deflection during assembly. After assembly, either straight or deflected, the joint shall be essentially rigid. Angles of deflection obtained during assembly shall not exceed five (5) degrees for a 12" diameter pipe.

B. The restraining glands used to join two ductile-iron pipes shall have auto-tork or twist-off set screws made of AISI 4140 high-strength, low-alloy steel with the corrosion resistance of Corten or equal. Acceptable Manufacturer: Standard International (Set Screw Retainer Glands or equal).

C. The restraining glands used to join a PVC-pipe connection to a standardized ductile-iron, mechanical-joint bell shall be accomplished with a restraining mechanism consisting of a plurality of individually activated foot-type gripping surfaces to maximize restraint capability, thus reducing point-stress. The retainer glands shall have a pressure rating equal to that of the PVC pipe on which it is used. Acceptable Manufacturer: EBAA Iron Inc. ("Megalug" Series 2000 PV or equal).

D. The retaining glands for use on bell or coupled-PVC-pipe joints shall be cast from ductile iron. These devices shall have a sufficient number of ductile tie bolts to restrain working and test pressure equal to that of the PVC pipe on which it is used. The clamp shall have a gripping surface on the inside diameter sufficient to hold working and test pressure. Acceptable Manufacturers: EBAA Iron Inc. (Series 1500 restrainer clamps) Uni-Flange (Series 1350 restrainer clamps or equal)

2.8 GATE VALVES

A. Non-rising-stem gate valves 4" through 12" shall be, as per the requirements of AWWA Specification C509, resilient-seated, bronze-stem valves with cast-iron or ductile-iron body and bonnet, and mechanical-joint ends in compliance with ANSI/AWWA Specification C111.

B. Valves shall be constructed to open right and shall have a (2"[2] operating nut. The design and machining of the valves shall permit packing, while the valve is in service without undue leakage, an "0"-Ring stuffing-box-type being acceptable. All operating nuts opening to the right shall be painted red as is standard industry practice.

C. The valves shall be designed and constructed to withstand a working pressure with the metric equivalent of 200 pounds per square inch and shall be hydrostatic tested, without leakage or distortion, under a water pressure of not less than the metric equivalent of 400 pounds per square inch as per the requirements of AWWA Specification C509-80 for resilient seat-valves.

D. In addition:

1. The thrust ring on the stem shall be properly and adequately bushed.
2. The thrusting shall be an integral part of the stem.
3. A full pipe size opening shall be attainable through the seat-ring.
4. All valves shall be furnished with mechanical-joint end accessories including bolts, glands, gaskets etc. Bolts and nuts shall be made of cast iron (Corten or equal).

E. Valves 3” and smaller shall be ball valves (FIP threads on both ends). Mueller 300TM ball valves or equal.

2.9 VALVE BOXES

A. All valve boxes, referred to herein, shall be cast-iron, slip-joint-type boxes with the words "Water Cast" on the lid. The valve boxes shall be 53" shaft-size and of a three-piece-type with a round base. Provide one steel-handle operating wrench for every three (3) valve boxes. The wrench shall have a tee handle with one pointed-end stem-of-length to operate valves, and a socket-fitting-valve operating nut. Valves set in deeper elevation shall have extensions added to the non-rising stems so that the standard-length wrenches will work. All valve boxes shall be Tyler 564S only (unless approved by the Utility).

2.10 POST INDICATOR VALVE

A. Post indicator valve shall be Mueller Co. Model No. A-20806: Adjustable Indicator Post, or approved equal. Post shall be mounted on Mueller 2360 Series, Resilient Wedge Gate Valve, or approved equal.

2.11 FIRE HYDRANTS

A. All Fire hydrants provided shall be MUELLER CENTURION, model A-423, or equal as approved by the Utility. AWWA Specification C502.

B. The fire hydrant assembly shall have a 6" mechanical-joint bell-inlet at the base, connected to a swivel by a solid adapter, a 6" branch gate-valve, and another swivel by a solid adapter, all connected to a mechanical-joint tee on the main. All hydrants

shall be furnished with mechanical-joint accessories, including bolts, nuts, glands and gaskets. Bolts and nuts shall be made of cast iron (Corten or equal).

C. The stand-pipe assembly shall be made in two (2) sections, which will be held together at ground level by means of a breakaway flange, designed to break off cleanly and evenly with the ground line.

D. The inside of the stand-pipe shall not be less than 7" in diameter. The size of the intake valve opening in the bottom of the hydrant shall be 5¼" in diameter and shall be a compression-type-valve opening against the inlet pressure so that the main valve remains closed if the barrel were to be impacted or broken off. The hydrant shall be designed for 200 pounds per square inch gage working pressure, capable of undergoing a test pressure of 400 pounds per square inch gage hydrostatic pressure.

E. Hydrants are to have the following outlet nozzles:

1. Two - 2½" N.S.T. hose nozzles
2. One – 5" N.S.T. steamer nozzle
3. The operating nut and nozzle cap nuts are to be standard (for 7/8" square wrench).

F. The hydrant shall have a positive, bronze-lined, non-corrodible-type drain-valve. When the hydrant is opened, the drip-valve will close the drain, and when the hydrant is closed, the drain will open.

G. The operating stem also shall be made with a breakaway-type coupling with rust-proof steel-connecting pins designed to breakaway upon impact. The operating nut is to be inserted into the cover plate or held in by means of a bronze lock, nut or screw, and shall be seated with an "O" ring. The operating-stem thread shall not have less than 1¼ outside the diameter with threads lubricated by means of a grease connection or similar device. The threads of the stem must also be sealed by a minimum of two (2) "O" rings from the waterway and also from the outside condensation. The operating nut must also have anti-friction bearings designed and installed to withstand the thrust developed during operation of the hydrant. Seat ring shall be of the bronze-type that can be easily removed or replaced. The hydrant valves and caps shall be furnished to open and close in the following directions that are standard with the Utility.

1. The hydrant valves shall open clockwise and close counter-clockwise, as is standard practice for all Utility-owned and maintained hydrants.
2. The caps shall be removed by turning counter-clockwise and installed turning clockwise.

H. The supplier shall supply one (1) operating wrench for every two (2) hydrants installed. Any other special tools required for maintenance (such as special seat wrenches) shall be supplied at no additional cost to the Owner.

I. The hydrants are to be painted and primed with two (2) coats of a red durable and weather-proof paint in accordance with AWWA Specification C502 of the latest revision (see plans for colors).

J. The distance from the ground line to the bottom of the inlet pipe shall be 1.5m (5') as specified. The hydrants shall be constructed in a manner such that extensions can easily be added at a later date as required. The interior surface of the hydrant shoe and the hydrant (seat valve) bottom-plate shall be epoxy-coated with a minimum thickness of nine (9) milliliters.

K. Acceptable Manufacturer: Mueller Co. (Super Centurion Hydrant No. A-423 or equal)

2.12 TRACING WIRE

A. A twelve (12) gauge copper-solid wire shall be attached to the entire length of the system. The continuous wire shall be looped up through the inside of the valve boxes and run through the set screws at the corporation stops to allow for easy connection of locating equipment.

2.13 SERVICES FITTINGS

A. CURB STOPS

1. All curb stops, 3/4" through 2" in size, shall be Class "200" plug or ball-type valves of extra heavy, all-brass construction with inlets and outlets machined and threaded for use with flared or compression joints, and furnished with two (2) coupling nuts, all in accordance with the latest revisions of the AWWA Specification C800. They shall have a heavy or thick tee-head operator, and a 90-(ninety)-degree rotation of the plug or ball.
2. Each stop shall be equipped with a standard cast-iron, Buffalo-type, arch-pattern curb box.
3. Ball valves shall have Teflon-coated balls and hard or synthetic rubber seat rings to effect seal.
4. Plug-type valves shall have "O" rings within the body or plug to create a water-tight seal.
5. Acceptable Manufacturers: Ford B11-777R only (unless approved by Utility).

2.14 CORPORATION STOPS

A. All corporation stops, 3/4" through 2" in size, shall be Class "200" plug or ball-type valves of extra heavy, all-brass construction, and shall have a flat, thick operating head, a 360-degree rotation of the operating head, and plug-type valves shall have a washer and adjusting nut on the bottom of the plug, all in accordance with the latest revisions of the AWWA Specification C800.

B. The inlet shall be machined and threaded with standard AWWA corporation-stop threads. The outlet shall be machined and threaded for use with flared, or compression joints, and furnished with one (1) coupling nut.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. The Utility and the Engineer must be notified forty-eight (48) hours prior to beginning any work. Also, the Utility and the Engineer shall be notified of any shutdown of the Utility's Water Distribution System forty-eight (48) hours prior to the interruption of the service as described earlier in the Specifications.

3.2 SURFACE CONDITIONS

A. Examine the areas and conditions under which the Work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.3 FIELD MEASUREMENT

A. Make necessary measurements in the field to assure precise fitting of the items in accordance with the approved design.

3.4 HANDLING

A. Handle the pipe accessories so as to ensure delivery to the trench in sound, undamaged condition:

1. Carry the pipe into position; do not drag.

2. Use pinch bars or tongs for aligning or turning the pipe only on the bare end of the pipe.

B. Thoroughly clean the interior of the pipe and accessories before lowering the pipe into the trench. Keep clean during the laying of operations by plugging, or another method approved by the Engineer.

C. Before installation, inspect each piece of the pipe and each fitting for defects:

1. Material found to be defective before or after the laying shall be replaced with sound material, meeting the specified requirements and without additional cost to the Owner.

D. Rubber gaskets: Store in a cool dark place until just prior to the time of installation.

3.5 PIPE CUTTING

A. Cut pipe neatly and without damage to the pipe.

B. Unless otherwise recommended by the pipe manufacturer and authorized by the Engineer, cut pipe with a mechanical cutter only.

1. Use wheel cutters when practicable.
2. Cut the plastic pipe in a square shape, and remove all burrs.

3.6 SEPARATION WITH SEWER LINES

A. Water mains shall be installed a minimum clear distance of ten feet (10') horizontally from sanitary sewers and shall be installed to go over the top of such sewers with a minimum of eighteen inches (18") of clearance at intersections of these pipes. Exceptions shall first be approved by the Town Engineer. In all instances, the distances shall be measured edge to edge. The minimum spacing between water mains and storm drains, gas lines, and other underground utilities, excepting sanitary sewers, shall be three feet (3') horizontally when the standard utility location cannot be maintained.

B. Where water lines are being designed for installation parallel with the other water mains, utility pipe, or conduit lines, the vertical separation shall be twelve inches (12") below or in such a manner which will permit future side connections of mains, hydrants, or services and avoid conflicts with parallel utilities without abrupt changes in vertical grade of the above mentioned main, hydrant, or service. Where crossing of utilities are required, the minimum vertical clearance shall be six inches (6").

3.7 JOINT DEFLECTION

A. Ductile iron pipe

1. Maximum allowable deflection will be given in AWWA Specification C600.
2. Table I shows maximum deflections for 18' lengths of pipe. For other lengths, deflection may vary proportionately.
3. If alignment requires deflection, exceeding limits shown in Table I, furnish special bends or a sufficient number of shorter lengths of pipe to provide angular deflections within the limits shown.
4. Locate the water mains as shown on the Plans. Deviation from Plan Location must be approved by the Engineer prior to installation.

TABLE 1 - DEFLECTION

DIAMETER	PUSH-ON JOINT PIPE	MECHANICAL JOINT PIPE
4"	19"	31"
6"	19"	27"
8"	19"	20"
10"	19"	20"
12"	19"	20"

B. PVC Pipe

1. The maximum allowable deflection shall not exceed applicable AWWA specifications or manufacturer's recommended maximum joint spacing.

3.8 EXCAVATION

A. The trench cross-sectional dimensions shall be as per OSHA standards. The trench bottom shall give full support to the pipe as shown on the Plans. Recesses shall be cut to receive any projecting hubs or bells.

B. In case a firm foundation is not encountered at the required grade, the unstable material shall be removed to such depth that when replaced with suitable material, usually "B" Borrow, (Section 211 of the INDOT Specifications Book), compacted, and properly shaped, it will produce a uniform and stable foundation along the entire length of the pipe.

C. De-watering

1. Remove all water, including rain water encountered during trench, and substructure the Work to an approved location by pumps, drains, and other approved methods.
2. Keep trenches and site construction area free from water.

D. Provide sheeting and shoring necessary for protection of the Work and for the safety of personnel, in accordance with current OSHA Standards.

1. Prior to backfilling, remove all sheeting.
2. Do not permit sheeting to remain in the trenches except when, in the opinion of the Engineer, field conditions or the type of sheeting or methods of construction, such as the use of concrete bedding, are such as to make removal of sheeting impracticable. In such cases, the Engineer may permit portions of the sheeting to be cut off and remain in the trench.

E. Excavate for Utilities by Open Cut

1. There are no mains and services called for as being bored.
2. If conditions at the site prevent such open cut, and if approved by the Engineer, boring may be used.
3. Short sections of a trench may be tunneled if, in the opinion of the Engineer, the conductor can be installed safely, and backfill can be compacted properly into such a tunnel.
4. Where it becomes necessary to excavate beyond the limits of normal excavation lines in order to remove boulders or other interfering objects, backfilling of the voids remaining after removal of the objects shall be as directed by the Engineer.
5. When the void is below the subgrade for the utility bedding, use suitable earth materials and compact to the relative density directed by the Engineer, but in no case to a relative density less than 90 (ninety) percent.
6. When the void is in the side of the utility trench or open cut, use suitable earth or sand compacted or consolidated as approved by the Engineer, but in no case to a relative density less than 80 (eighty) percent.

7. Remove boulders and other interfering objects and backfill voids left by such removals, at no additional cost to the Owner.

F. Trench to the minimum width necessary for proper installation of the utility, with sides as nearly vertical as possible, and as allowed by current OSHA Standards. Accurately grade the bottom of the trench to provide uniform bearing for the utility.

G. Depressions

1. Dig bell holes and depressions for joints after the trench has been graded.
2. Provide uniform bearing for the pipe on the prepared bottom of the trench.
3. Except where rock is encountered, do not excavate below the depth indicated or specified.
4. Where rock is encountered, excavate rock to a minimum overdepth of 4" below the trench depth indicated or specified.

H. Where utility runs traverse of public property are subject to governmental utility company jurisdiction, provide depth-bedding, over the main, in addition to other requirements as set forth by a legally constituted authority having jurisdiction, but in no case less than the depth shown in the Contract Documents.

I. Cover

1. Provide minimum trench depth to maintain a minimum of 48" cover over the top of the installed pipe below the existing grade or proposed finish grade. The lower of the two (2) profiles at any given point shall be deemed the controlling grade. Provide additional cover over the main at areas as designated on the Plans in order to provide the necessary clearances under both existing and proposed other utilities.

3.9 PLACING AND LAYING

A. General

1. Lower pipe and accessories into the trench by means of derrick, ropes, belt slings, or other equipment approved by the Engineer.
2. Do not dump or drop any of the materials of this Section into the trench.
3. Except where necessary in making connections to other lines, lay pipe with the bells facing in the direction of the laying.
4. Rest the full length of each section of pipe solidly on the pipe bed, with recesses excavated to accommodate bells, couplings, and joints.
5. Take up and relay pipe that has the grade or joint disturbed after laying.
6. Do not lay the pipe in water, or when trench conditions are unsuitable for the work; keep water out of the trench until jointing is completed.

B. Connections

1. Use specials and fittings to suit the actual conditions where connections are made between new work and existing mains.
2. Use only those specials and fittings approved by the utility having jurisdiction.

C. Sleeves

1. Where the pipe passes through the walls of the valve pits or structures, provide cast-iron-wall sleeves.
2. Fill the annular space between the walls and sleeves with rich cement mortar.
3. Fill the annular space between the pipe and sleeves with mastic.

3.10 BEDDING

A. Provide Local Utility and manufacturer's approved bedding material.

3.11 BACKFILLING

A. General

1. Do not completely backfill the trenches until the required pressure and leakage tests have been performed, and until the utility's systems as installed, conform to the requirements specified in the pertinent Sections of these Specifications.
2. Except where otherwise specified or directed for special conditions, backfill the trenches to the ground surface with selected material approved by the Engineer.
3. Re-open trenches, which have been improperly backfilled, to a depth as required for proper compaction. Refill and compact as specified, or otherwise correct to the approval of the Engineer.
4. Do not allow or cause any of the Work performed or installed to be covered up or enclosed by the Work of this Section prior to required inspections, test, and approvals.
5. Should any of the Work be so enclosed or covered up before it has been approved, uncover all such work and, after approvals have been made, refill and compact as specified, all at no additional cost to the Owner.

B. Lower Portion of the Trench (Bedding)

1. Deposit the approved backfill and bedding material in layers of a 6" maximum thickness, and compact with suitable tampers to the density of the adjacent soil, or grade as specified herein, until there is a cover of not less than 12" over the utility lines.
2. Take special care in backfilling and bedding the operations so as not to damage the pipe and pipe coatings.

C. Special Backfill for the Water Main

1. The backfill material shall be granular material: sand, nollstone or other approved material.
2. Compaction shall be in accordance with Section 211.04 of the 1995 INDOT Standard Specifications.

3.12 JOINTING

A. Pipe Joints

1. Cast-iron pipe, ductile-iron pipe, mechanical joints, and push-on-type joints are to be installed in accordance with AWWA Specification C600, modified as necessary by the recommendation of the ductile-iron pipe.
2. Make connections between the different types of pipes and accessories with transition fittings.
3. Rubber gaskets: Handle, lubricate where necessary, and install in strict accordance with the recommendations of the manufacturer.

3.13 SETTING VALVES AND VALVE BOXES

A. General

1. Center valve boxes on the valves, setting plumb.
2. Tamp earth and fill around each valve box to a distance of 4' on all sides, or to the undisturbed trench fact if less than 4'.
3. Tighten stuffing boxes, and fully open and close each valve to assure that all parts are in working condition.

B. Service Boxes

1. Where the water lines are located below the paved streets having curbs, install the boxes directly in back of the curbs.
2. Where no curbing exists, install the boxes in accessible locations beyond the limits of street surfacing, walks, and driveways, or as shown on the Drawings.

3.14 RESTRAINING

A. General

1. Provide metal-tie rods and clamps or lugs on plugs, caps, tees, and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, and on water lines 6" in diameter or larger.
2. Provide concrete thrust-blocking with a compressive strength of the metric equivalent to 2,500 pounds per square inch in twenty-eight (28) days only at locations approved by the Engineer.

B. Installation

1. Locate the thrust-blocking between solid ground and the fitting to be anchored.
2. Unless otherwise shown or directed by the Engineer, place the base and the thrust-bearing sides of the thrust-blocking directly against the undisturbed earth.
3. The sides of the thrust-blocking not subject to thrust may be placed against forms.
4. Place the thrust-blocking in such a way so that the fitting joints will be accessible for repair.
5. Protect steel rods and clamps by galvanizing, or by coating with bituminous paint.

3.15 FIRE HYDRANT LOCATIONS

A. All fire hydrants shall be located behind or outside the existing or proposed sidewalk/curb/pavement as shown on the plans.

B. Each fire hydrant shall have an auxiliary valve and valve box which will permit repair of the hydrant without shutting down the main supplying the hydrant. Such auxiliary valves shall be resilient seat gate valves. The auxiliary valve shall have mechanical joint-flange joint ends. The valve shall be connected directly to the water main using a flange joint tee, tie rods, and thrust blocked.

C. Hydrants shall not be located within twenty (20') of any building, nor will they be blocked by parking. The large hydrant port should face the road or travel way.

D. Guard posts a minimum of three feet (3') high shall be required for protection from vehicles when necessary. Such protection shall consist of four inch (4") diameter steel pipes six feet (6') long filled with concrete and buried a minimum of three feet (3') deep in concrete and located at the corners of a Six foot (6') square with the hydrant located in the center.

3.16 TESTING AND INSPECTING

A. All new water systems (lines, valves, hydrants, & services) shall be individually pressure tested, chlorinated and tested for bacteria. All testing shall be performed in accordance with the Utility's Standard Specifications and in the presence of a Utility's inspector.

B. B. Provision for chlorination of service branches is shown on the plans. Four inch (4”) and larger lines are required to be bleached to either the point of termination or backflow device.

C. C. Each blow off valve over one will be charged an additional $50.00/each for testing, which shall be included in the Bid.

D. No piping smaller than 4 inch shall be installed until all testing and disinfection of 4 inch and larger piping is complete and approved.

3.17 FINAL CLOSEOUT AND ACCEPTANCE

A. The Contractor shall be responsible for obtaining final acceptance of all portions of the water main extension that are to be accepted for maintenance by the Local Utility. This includes preparation and submittal of properly formatted (as required by the Local Utility) as-built (record) drawings certified by a registered Professional Engineer, along with all other warranties, guarantees, easements, etc.

1. As Built Drawings
   a. The as-built drawings shall include the GPS Coordinates using the AND 1983 State Plane Indiana West FIPS 1302 Feet Coordinate System indicating the

location of all fittings, valves, Fire Hydrants, service line taps, stop cocks, water meters, and air release valves.

b. As-built information shall also include photos of all tie-in connections from the new main to the existing mains. One hard copy on glossy 4 x6 format placed in sleeves and bound in a 3 ring binder shall be supplied. Each photo shall reference location and orientation of photo. One copy of all photos shall also be supplied to the owner in digital format on a flash drive with the title of each photo indicating the location of the tie-in (examples - morgan & weinbach 1.jpg, morgan & weinbach 2.jpg, morgan & oak hill.jpg).

c. As-built information shall include the depth, direction to open (c or ccw), and number of turns on every valve installed.

END OF SECTION 221113

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Specialty valves.
3. Transition fittings
4. Dielectric fittings
5. Flexible connectors.

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.

1.2 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

C. Comply with NSF 61 for potable domestic water piping and components.

D. All piping shall be tested for working pressure of 150 psi minimum and temperature of 210 degree Fahrenheit, as required by Minnesota code.

E. Water service line must be installed at least 10 feet horizontally from any manhole, catchbasin, or any other potential source of contamination (see Minnesota Rules, part 4715.1710, subpart 3).

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 Tubing: ANSI H23.1, ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.

B. Soft Copper Tube: ANSI H23.1, ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ANSI H23.1, ANSI B16.22, ANSI B1618, ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASTM B62, ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. ANSI A21.15 compliant.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. ANSI A21.15 compliant.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. ANSI A21.15 compliant.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe:

1. ASTM A 53/A 53M, Type E, Grade B, Standard Weight.
2. Include ends matching joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.

C. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Malleable-Iron Unions:

1. ASME B16.39, Class 150.
2. Hexagonal-stock body.
3. Ball-and-socket, metal-to-metal, bronze seating surface.
4. Threaded ends.

E. Flanges: ASME B16.1, Class 125, cast iron.

2.5 CPVC PIPING (building distribution system only)

A. CPVC Pipe: ASTM F 441/F 441M, Schedule 40.

1. CPVC Socket Fittings: ASTM F 438 for Schedule 40.
2. CPVC Threaded Fittings: ASTM F 437, Schedule 80.
3. Pipes 2-1/4inch to 6-inch in size must be schedule 80 and must also comply with ASTM Standard F441.

B. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings.

C. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

D. CPVC piping and fittings shall also be compliant with ASTM Standard F441, ANSI 119.1, ANSI 119.2, NSF14, FHA bulletin #76 and CSA-B137.6

E. The installation of chlorinated polyvinyl chloride (CPVC) pipe for water distribution systems must meet the following requirements (see Minnesota Rules, part 4715.0520):

1. Pipes less than 2 -inch in size must comply with ASTM Standard D2846.
2. Pipes 2 -inch to 6-inch in size must be schedule 80 and must comply with ASTM Standard F441.
3. Solvent weld joints must either include the use of a primer which is of contrasting color to the pipe and cement or a one-step solvent cement complying with ASTM Standard F493 and ASTM Standard D2846 (see Minnesota Rules, part 4715.0810, subpart 2).
4. The installation must be in accordance with International Association of Plumbing and Mechanical Officials (IAPMO) installation Standards 20-98.

2.6 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493 and ASTM Standard D2846.

1. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Solvent cement and adhesive primer 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."

2.7 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

C. CPVC Union Ball Valves:

1. Description:

a. Standard: MSS SP-122.
b. Pressure Rating: 125 psig at 73 deg F.
c. Body Material: CPVC.
d. Body Design: Union type.
e. End Connections for Valves NPS 2 and Smaller: Detachable, socket.
f. End Connections for Valves NPS 2-1/2 to NPS 4: Detachable, socket or Flanged.
g. Ball: CPVC; full port.
h. Seals: PTFE or EPDM-rubber O-rings.
i. Handle: Tee shaped.

D. CPVC Ball Check Valves:

1. Description:

a. Pressure Rating: 125 psig at 73 deg F.
b. Body Material: CPVC.
c. Body Design: Union-type ball check.
d. End Connections for Valves NPS 2 and Smaller: Detachable, socket.
e. End Connections for Valves NPS 2-1/2 to NPS 4: Detachable, socket or Flanged.
f. Ball: CPVC.
g. Seals: EPDM- or FKM-rubber O-rings.

E. CPVC Gate Valves:

1. Description:

a. Pressure Rating: 125 psig at 73 deg F.
b. Body Material: CPVC.
c. Body Design: Nonrising stem.
d. End Connections for Valves NPS 2 and Smaller: Socket.
e. End Connections for Valves NPS 2-1/2 to NPS 4: Socket or Flanged.
f. Gate and Stem: Plastic.
g. Seals: EPDM rubber.
h. Handle: Wheel.

2.8 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. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

a. Charlotte Pipe and Foundry Company.
b. Harvel Plastics, Inc.
c. Spears Manufacturing Company.

2. Description:

a. CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.

b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

D. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

a. Colonial Engineering, Inc.
b. NIBCO Inc.
c. Spears Manufacturing Company.

2. Description:

a. CPVC four-part union.
b. Brass or stainless-steel threaded end.
c. Solvent-cement-joint or threaded plastic end.
d. Rubber O-ring.
e. Union nut.

2.9 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 Unions:

1. Description:

a. Pressure Rating: 150 psig at 180 deg F.
b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Description:

a. Factory-fabricated, bolted, companion-flange assembly.
b. Pressure Rating: 150 psig.
c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric Couplings:

1. Description:

a. Galvanized-steel coupling.
b. Pressure Rating: 300 psig at 225 deg F.
c. End Connections: Female threaded.

d. Lining: Inert and noncorrosive, thermoplastic.

2.10 FLEXIBLE CONNECTORS

A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

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.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

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 gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages 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 domestic water piping level and plumb.

G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

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 pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

R. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.

S. Install thermometers on outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

T. 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."

U. 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."

V. 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."

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. 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. Apply primer.
   2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

H. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 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 "Domestic Water Piping Specialties."

   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 balancing 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. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

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 and Smaller: Fitting-type coupling.
2. NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

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 and Smaller: Use dielectric couplings or unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

D. Dielectric Fittings for NPS 5 to NPS 6: Use dielectric flange kits.

3.7 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.

B. Install bronze-hose flexible connectors in copper domestic water tubing.

C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.8 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint 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 and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

3. 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.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters and/or as indicated in local code whatever is LESS:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters and/or as indicated in local code whatever is LESS:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters and/or as indicated in local code whatever is LESS:

1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
2. NPS 1-1/4 to NPS 2 48 inches with 3/8-inch rod.
3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.

J. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger and/or as indicated in local code whatever is LESS.

K. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters and/or as indicated in local code whatever is LESS:

1. NPS 1 and Smaller: 32 inches with 3/8-inch rod.

L. Install hangers for vertical PEX piping every 48 inches and/or as indicated in local code whatever is LESS.

M. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.9 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. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. 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.
4. 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 and larger.

3.10 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.

3.11 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 and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced 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 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.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.12 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 hot-water flow 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.

3.13 CLEANING

A. Clean and disinfect 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 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is 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.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.14 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-building-slab, domestic water, building service piping, NPS 3 and smaller, shall be the following:

1. Soft copper tube without joints.

D. Under-building-slab, domestic water, building-service piping, NPS 4 and larger, shall be the following:
   1. Push-on-joint, ductile-iron pipe; standard- or compact- pattern push-on-joint fittings; and gasketed joints.

E. Aboveground domestic water piping, NPS 2-1/2 and smaller, shall be the following:

   1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed or soldered joints.
   2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Hose bibbs.
4. Wall hydrants.
5. Drain valves.
6. Water hammer arresters.

B. See Division 22 Section "Domestic Water Piping" for water meters.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 QUALITY ASSURANCE

A. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Product data
2. Product certificates
3. Wiring Diagrams
4. Test and Balance report
5. Field quality-control reports.
6. Warranty: Sample of special warranty.

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 (Substitutions: See Section 016000 – Product Requirements):

   a. Ames Co.
   b. Watts Industries, Inc.; Water Products Div.
   c. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. MIFAB, Inc.
   b. Watts Industries, Inc.; Water Products Div.
   c. Woodford Manufacturing Company.
   d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.
3. Body: Bronze, non-removable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

2.2 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Watts Industries, Inc.; Water Products Div.
   b. Zurn Plumbing Products Group; Wilkins Div.
   c. MIFAB

2. Standard: ASSE 1012.

3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2 or NPS 3/4.
5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Rough bronze.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Watts Industries, Inc.; Water Products Div.
   b. Zurn Plumbing Products Group; Wilkins Div.
   c. MIFAB

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through or vertical flow.
8. Accessories:

   a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
   b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
   c. Provide full size hard copper drain line from unit to nearest floor drain.

C. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Watts Industries, Inc.; Water Products Div.
   b. Zurn Plumbing Products Group; Wilkins Div.
   c. MIFAB

2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 HOSE BIBBS

A. Hose Bibbs: As scheduled on drawings.

2.4 WALL HYDRANTS

A. Wall hydrants: As scheduled on drawings.

2.5 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 minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
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.

2.6 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Josam Company.
   b. MIFAB, Inc.
   c. Sioux Chief Manufacturing Company, Inc.
   d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
   g. Wade.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

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 hammer arresters in water piping according to PDI-WH 201.

D. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

E. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Intermediate atmospheric-vent backflow preventers.
2. Reduced-pressure-principle backflow preventers.
3. Primary, thermostatic, water mixing valves.

F. 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."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each reduced-pressure-principle backflow preventer and/or 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.

END OF SECTION 221119

SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Work Description:

This work shall consist of the construction of a sanitary sewerage system in accordance with these specifications and in reasonably close conformance with the lines and grades shown on the plans or as directed.

B. Fees:

1. The Owner will pay all sanitary sewer tap fees to Utility.
2. The Contractor shall pay for all construction inspection fees required by the Utility.

C. General:

The Contractor shall provide all labor, materials, equipment and tools necessary for the proper installation of sewer pipe of the size, or sizes shown on the Drawings. This will include all mains, laterals, wyes, fittings and appurtenances necessary for a complete and functional sewerage system.

1.2 JOB CONDITIONS

A. Handling Material into Trench:

1. Use the proper implements, tools, and facilities to provide for the safe and convenient prosecution of the work.
2. Carefully lower all pipe and fittings into the trench piece by piece in such a manner as to prevent damage to materials. Do not dump or drop materials into trench.
3. Unless specifically directed otherwise by the Engineer, not more than 100 feet of trench shall be opened ahead of pipe laying work of any one crew, and not more than 100 feet of open ditch shall be left behind the pipe laying work of any one crew. Watchmen or barricades, lanterns and other such signs and signals as may be necessary to warn the public of the dangers in connection with open trenches, excavation and other obstructions, shall be provided by and at the expense of the Contractor. Conformance to all state highway requirements shall be the responsibility of the Contractor when encroachment on highway right-of-way is necessary.

4. When so required or when directed by the Engineer, only one-half of street crossings and road crossing shall be excavated before placing temporary bridges over the side excavated for the convenience of the traveling public. All backfilled ditches shall be maintained in such a manner that they will offer no hazard to the passage of traffic. The

convenience of the traveling public and property owners abutting shall be taken into consideration. All public or private drives shall be taken into consideration and shall be promptly backfilled or bridged at the direction of the Engineer. Excavated materials shall be disposed of so as to cause the least interference, and in every case the disposition of materials shall be satisfactory to the Engineer. Trenches in which pipes are to be laid shall be excavated in open cut to the depths shown on the approved plans, cut sheets or as specified by the Engineer.

5. Where conditions exist that may be conductive to slides or cave-ins, proper and adequate sheeting, shoring and bracing shall be installed to provide safe working conditions and to prevent damage to work. Trenches shall be kept free of water during the laying of the pipe and until the pipeline has been backfilled.

PART 2 – PRODUCTS

2.1 SEWER PIPE MATERIALS

A. Plastic Pipe for Gravity Sewers

1. Gravity sewer laterals 6” and smaller shall conform to AWWA C900-81 DR 18, Polyvinyl Chloride (PVC) material; inside nominal diameter as specified, style solvent sealed joint end.
2. Gravity sewers 8” to 12” shall conform to AWWA C900-81 DR 18, Polyvinyl Chloride (PVC) material.
3. Gravity sewers 14” to 24” shall conform to AWWA C905-81 DR 18, Polyvinyl Chloride (PVC) material.

B. Pipe for force mains 4” diameter shall conform to commercial standard for polyvinyl chloride plastic pipe (PVC) ASTM D-2241-latest edition, 200 PSI pressure rating, SDR 21.

1. Tees for lines 2 inch and smaller shall be brass, threaded and joined to PVC pipe with the use of a 2 inch male iron pipe compression coupling (bronze) with lock ring.
2. All other fittings used in conjunction with Force Maws less than 4 inches in diameter (200 psi minimum pressure pipe) shall be schedule 80 PVC fittings and shall be restrained utilizing thrust blocking as specified.
3. Pipe and fittings shall have integral molded bells for bell and spigot type joints with elastomeric ring gaskets providing a water tight seal. Gaskets shall be certified by the manufacturer to be chemically immune to normal sewage and sewer gas and the gasket design arrangement on the bell shall be approved by the Engineer.
4. All pipe fittings shall be molded or otherwise made as one piece integral units.
5. All connections to manholes or other structures shall be made using one piece elastomeric rings securely fitted to the outside of the pipe with stainless steel bands.
6. Adapters as furnished by the pipe manufacturer shall be used to connect PVC pipe to all other types of pipes of fittings.
7. Construction methods including Trenching, Bedding, Laying, Backfilling, etc., shall be as hereinafter provided except that Bedding material shall extend to 0.5 the pipe diameter and special care shall be required in placing and tamping the cover material above the pipe.

C. Pipe for force mains 4” to 12” shall conform to AWWA C900-81. All PVC pipe shall have a dimension ratio no greater than 18.

D. Ductile Iron Pipe

1. Ductile iron pipe shall be Class 52 for sizes 4” through 12” and Class 51 for 16” and larger, conforming to ANSI/AWWA Specifications C151/A-21.51. The ductile iron pipe fittings shall be cement lined and seal coated as per AWWA Specification C104 with rubber gaskets conforming to AWWA Specification C111. The exterior of all fittings shall be coated with a bituminous coating as per AWWA Specification C110.
2. The ductile iron pipe shall be a mechanical joint or push-on type as specified on the Drawings. The pipe shall be furnished with mechanical joint accessories, including bolts and nuts that shall be made of cast iron (Corten or equal). Couplings shall be made of an iron-body sleeve, assembly-fabricated to match the outside diameter of the pipes to be joined. Sleeves shall comply with ASTM A126, Class B, gray iron. Followers shall comply with ASTM Specification A47, Grade 32510 or ASTM A536 ductile iron. The gasket shall be made of rubber in conformance with AWWA Specification C111.

2.2 PIPE BEDDING

A. PVC pipe shall be bedded on 4" of No. 5 stone under the pipe. No. 5 stone shall be used as backfill to an elevation one foot (1’) above the top of the pipe for all PVC pipe except PVC C-900.

B. Pipe shall not be laid directly on rock in the trench bottom. A minimum of 8" of #7 stone shall be placed between the bottom of the sewer pipe and the rock.

C. If the natural base of the trench is not satisfactory as a bedding for the sewer pipe one of the following methods shall be used:

1. Dry Mix Concrete Bedding - In areas where wet mucky soil, unstable soil or "running sand" is encountered or as otherwise directed by the Engineer, sewer pipe shall be laid on Dry Mix Concrete. the concrete shall be minimum 2500 psi 38 day strength Class "B". The cement, sand and stone shall be thoroughly mixed (no water) and placed in the trench to a minimum depth of 4 inches below the bottom of the pipe. Dry mix concrete shall be thoroughly tamped along each side of the pipe to a height equal to .3 of the pipe diameter. Only enough water shall be added to the concrete, after the pipe is in place, to cause hydration of the cement. After water is added the pipe grade shall be rechecked, adjusted as necessary and the concrete retamped along the side. The sewer trench shall be kept water free during the pipe laying and until the concrete has set.
2. Improved Bedding - All sewer pipe shall, as a standard practice, be laid using Improved Bedding. Such bedding (Crushed limestone, #8, #9, or #11) shall be placed a minimum depth of 4 inches below the bottom of the pipe barrel and thoroughly tamped along each side of the pipe to a height equal to 0.3 of the pipe diameter. (See Exhibit).
3. Special Subgrade Improvement - When directed by the Engineer, in situ table materials below the normal trench depth shall be removed to a depth sufficient to provide a layer of crushed limestone (#6 or #78) to support the pipe and prevent settlement. The pipe

shall then be laid on Dry Mix Concrete Bedding (1.3.1) or "Improved Bedding: 5.3.3." placed over the Subgrade Improvement.

2.3 MANHOLES

A. Reinforced concrete manholes shall conform with ASTM C-478.

B. Minimum inside diameter, except for the eccentric cone, shall be 48”.

C. Joints shall be constructed Tylox Superseal, as manufactured by Hamilton Kent or equal with gaskets conforming with ASTM C-443.

D. Precast manhole bases shall conform to ASTM C-478 with a steel finish flowline channel and ledge.

E. Precast bases shall have a compression fit gasket, KS 750 style gasket (or equal) for 8” pipes, KS 500 (or equal) for 10” pipes, and a PS-X gasket (or equal) for 6” pipes, all as manufactured by Pres-Seal Gasket Corp.

F. The diaphragm shall meet ASTM C-923-79.

G. Precast riser rings (3500 psi concrete rings)

   1. Rings shall be mounted atop manhole cone or flat top with 1-1/4” butyl rubber base sealant SS-S-210A. Once in place, rings shall be grouted inside and out with a nonshrink grout.

H. Heavy duty manhole castings will be East Jordan 1022 with Type A solid cover or equal and machined casting and frame meeting ASTM 448, Class 35. Casting shall be secured to rings or cone using a butyl rubber sealant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locating Near Water Mains:

Horizontal Separation - Whenever possible, sewers should be laid at least 10 feet, horizontally, from any existing or proposed water main. Should location conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to water main if:

1. It is laid in a separate trench.
2. It is laid in the same trench with water mains located at one side of a bench of undisturbed earth.
3. In either case, the elevation of the crown of the sewer is at least 24 inches below the invert of the water main.

4. A sewer crossing above a potable water line shall be waterworks grade ductile iron pipe at locations shown in the plans.
5. The crossing shall be at the midpoint of the section of water pipe. The ductile iron sewer pipe shall be laid with a 20 foot section of pipe centered at the water line to insure that joints are as far as possible from the crossing.
5. Whenever sewers must cross under water mains, the sewers shall be laid at such an elevation that the top of the sewer is at least 24 inches below the bottom of the water main. When the elevation of the sewer cannot be buried to meet the above requirements, the sewer line shall be constructed with slip-on or mechanical joint cast iron pipe, pressure pipe or prestressed concrete cylinder pipe for a distance of 10 feet on each side of the water line. One full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.

B. Trench Excavation:

1. Trench excavation shall not advance more than 100' feet ahead of the completed pipe work, except where in the opinion of the Engineer it is necessary to drain wet ground. The trench must be dewatered when joints are made and kept dewatered until sufficient time has elapsed to assure hardening of the jointing material.
2. The bottom of the trench shall be continually checked. Any excavation made below necessary grade shall be refilled only with sand or fine gravel, or properly graded crushed rock, thoroughly compacted, all at the Contractor's expense. The bottom of the trench shall be slightly rounded to provide as much bearing area as possible for the lower quarter of the pipe. Bell holes of sufficient depth to insure an even bearing on the main body of the pipe shall be dug in the bottom of the trench whenever bell and spigot pipe are being laid.

C. Pipe Bedding:

1. All pipe shall as a minimum be installed per the manufacturer's specifications.
2. Pipe that will have an earthen cover greater than 9 feet shall be bedded in #7 stone an minimum of 6 inches around the outside of the pipe.
3. If the ground under the pipe bedding needs to be stabilized with larger stone, only #7 stone should come in contact with the pipe.
4. B-Borrow will not be allowed for use as pipe bedding.

D. Pipe Installation:

1. The pipes shall be installed according to the manufacturer's recommendations.
2. Vitrified clay pipe and fittings shall be installed to conform to ASTM C-12 (latest edition).
3. Sewer extensions shall be built and verified to the approved grade by use of laser.
4. Lay pipe in finished trench commencing at the lowest point so that spigots point in the direction of flow and the bell ends point opposite the direction of flow.
5. Lay all pipe with ends abutting and true to line and grade. Fit and match pipe so that when laid it forms a sewer with a smooth uniform invert.

E. Pipe Backfilling:

1. All sewer main pipe should be backfilled the same day as installed. In future street areas, the excavated material shall be mechanically compacted, or ground material

meeting Indiana Department of Transportation Specifications may be placed and compacted.

2. Care should be used to avoid unbedding the pipe when backfilling, i.e. backfill should be pushed in the opposite direction of installing the pipe.

F. Field Inspection:

1. The Owner's Engineer and the Utility's Engineer/Inspector will inspect all piping and appurtenances for soundness and infiltration. The sewerage system shall be constructed to have a minimum amount of infiltration and at a slope sufficient to give the flow a mean velocity, when flowing full, of not less than 2.0 feet per second.
2. The Owner's Engineer and the Utility's Engineer/Inspector will reject all materials found to have cracks, flaws or other material defects. All rejected materials shall be promptly removed from the site.

3.2 TESTING AND FINAL ACCEPTANCE

A. Final Acceptance:

1. Prior to final inspection and acceptance, the inside of all pipes and appurtenances shall be clean of all foreign materials.

2. Any pipe found to have loose joints or showing any evidence of leakage will not be accepted, and will be repaired at the Contractor's expense.

3. Maximum allowable leakage rate shall be as specified herein.

4. All flexible piping shall be tested for deflection by a mandrel test. The mandrel test shall be performed by the Contractor in the presence of the Owner's Engineer or the Utility's Engineer/Inspector using a rigid ball or mandrel with a diameter equal to 95% of the inside diameter of the pipe. The mandrel shall be pulled through the pipe by hand with no mechanical assistance. The section of sewer pipe fails if, for any reason, the mandrel cannot pass through the section of sewer pipe. PVC pipe and truss pipe used in gravity sewers shall be mandrel tested.

5. Prior to acceptance of the sewerage system, all sewers will be tested for leakage. After laying, backfilling and compacting, the Contractor shall test the sewer in the presence of the Owner's Engineer or the Utility's Engineer/Inspector.

   a. Building sewers shall be considered a part of the main to which they are connected and tested as part of the overall system without adjustment of test time to compensate for the smaller diameter pipe.
   b. The pressure gauge used shall be supplied by the Contractor, shall have minimum divisions of 0.25 psi, and shall have an accuracy of 0.10 psi. Accuracy and calibration of the gauge shall be certified by a reliable testing firm at six month intervals or when required by the Engineer. In addition, the Utility's

Engineer/Inspector may compare the Contractor's gauge with a municipally owned gauge at any time.

c. The air test shall, as a minimum, conform to the test procedure described in ASTM C-828 for clay pipe, ASTM C-924 for concrete pipe, ASTM F-1417 for plastic pipe, and for other materials test procedures approved by the regulatory agency.

6. Manholes shall be air tested in accordance in accordance with ASTM C1244-93, Standard Test Method for Concrete Sewer Manholes by Negative Air Pressure (Vacuum) Test).

B. The Contractor, at his expense, will locate and repair any damage to the pipe line and its appurtenances or to any structure resulting from the testing. If the section tested fails the test, it shall be repaired and retested at the Contractor's expense until the measured leakage is within the allowable limits.

END OF SECTION 221313

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.

B. See Division 22 Section "Chemical-Waste Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.

1.2 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.

1.3 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; and "NSF-drain" for plastic drain piping.

C. Water service line must be installed at least 10 feet horizontally from any manhole, catchbasin, or any other potential source of contamination (see Minnesota Rules, part 4715.1710, subpart 3).

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 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ANSI 21.8, ASTM A 74, Service class.

1. Gaskets: ANSI 21.51, AWWA C151, ASTM C564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.

1. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
2. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

3. Hubless cast iron pipe and fittings shall be compliant with CISPI standard 301-69T and CSA/CAN 3-B70.

2.4 PVC PIPE AND FITTINGS

A. PVC unthreaded Pipe: ASTM D 2665, NSF14, CSA-B181.2, CS272, ASTM D 2665, Schedule 40, solid-wall drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer 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."

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement 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.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Non-pressure Transition Couplings:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Dallas Specialty & Mfg. Co.
        2) Fernco Inc.
        3) Mission Rubber Company; a division of MCP Industries, Inc.
        4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.

    b. Standard: ASTM C 1173.
    c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    d. Sleeve Materials:

        1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
        2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
        3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

4. Shielded, Non-pressure Transition Couplings:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Cascade Waterworks Mfg. Co.
        2) Mission Rubber Company; a division of MCP Industries, Inc.

    b. Standard: ASTM C 1460.
    c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Sanitary Sewers."

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 sanitary drains connect to building sanitary sewers.

D. 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."

E. 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.

F. 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.

G. 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 2-1/2 and smaller; 1 percent downward in direction of flow for piping NPS 3 and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow for piping NPS 2-1/2 and smaller; 1 percent downward in direction of flow for piping NPS 3 and larger.2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

H. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

I. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.

J. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

K. Install underground ABS and PVC soil and waste 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 "Sleeves and Sleeve Seals for Plumbing Piping."

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."

3.2 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
2. Hubless Joints: Make with rubber gasket and sleeve or clamp.

C. Plastic, Non-pressure-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. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.3 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, non-pressure transition couplings.

3.4 VALVE INSTALLATION

A. General-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.

1. Use gate or full-port ball valve for piping NPS 2 and smaller.
2. Use gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type,

unless otherwise indicated.
2. Install backwater valves in accessible locations.
3. Backwater valves are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.5 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 and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

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 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: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6and larger: 60 inches with 3/4-inch rod.
5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6 and larger: 12 feet with 3/4-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6 and larger: 48 inches with 3/4-inch rod.

J. Install supports for vertical ABS and PVC piping every 48 inches.

K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

B. 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. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
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. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
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 and larger.

3.7 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.

1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
2. Prepare reports for tests and required corrective action.

3.8 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.

3.9 PROTECTION

A. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.10 PIPING SCHEDULE

A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

C. Aboveground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:

1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
3. PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. PVC may not be used if horizontal lengths are greater than 35 feet in total length. No stack can exceed 35 feet in total height unless a code approved expansion and contraction joint is installed at intervals not to exceed 35feet. ABS or PVC may not be used if located above a ceiling that is considered a mechanical plenum.

D. Aboveground, soil, waste, and vent piping NPS 5 and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.

3. PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. PVC may not be used if horizontal lengths are greater than 35 feet in total length. No stack can exceed 35 feet in total height unless a code approved expansion and contraction joint is installed at intervals not to exceed 35feet. ABS or PVC may not be used if located above a ceiling that is considered a mechanical plenum.

E. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:

1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
4. PVC pipe, PVC socket fittings, and solvent-cemented joints.
5. PVC piping system must be laid on a continuous granular bed. Installation must comply with ASTM D2321.

F. Underground, soil and waste Piping NPS 5 and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
3. PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. ABS or PVC piping system must be laid on a continuous granular bed. Installation must comply with ASTM D2321.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains/sinks.
3. Miscellaneous sanitary drainage piping specialties.

1.2 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Product data

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Cleanouts (CO):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Sioux Chief #851 provide with coring plug and coring sleeve to protect drain during concrete pour**,** or a comparable product by one of the following (Substitutions: See Section 016000 – Product Requirements):

a. Josam Company; Josam Div.
b. MIFAB.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Sioux Chief Manufacturing Company, Inc.,
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.
g. Wade.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping.
4. Body Material: Hubless, cast-iron soil pipe connected piping.
5. Closure: Adjustable countersunk or raised-head, brass.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Floor Cleanouts (FCO):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Sioux Chief #852 provide with coring plug and coring sleeve to protect drain during concrete pour, or a comparable product by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Josam Company; Josam Div.
   b. MIFAB.
   c. Sioux Chief Manufacturing Company, Inc.
   d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Light Commercial Operation.
   g. Zurn Plumbing Products Group; Specification Drainage Operation.
   h. Wade.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing, as required to match finished floor level.
5. Body or Ferrule: to match piping.
6. Clamping Device: Not required.
7. Outlet Connection: Spigot or Threaded.
8. Closure: Brass plug with straight threads and gasket, Cast-iron plug or Plastic plug to match body.
9. Adjustable Housing Material: Cast iron or Plastic to match pipe with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy for concrete floor & tile floor. Nickel-bronze, copper alloy with carpet tag (-14) for carpet floors.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Medium Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser cleanout.

C. Wall Cleanouts (WCO):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Josam #58790 or a comparable product by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Josam Company; Josam Div.
   b. MIFAB
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

d. Tyler Pipe; Wade Div.
e. Sioux Chief Manufacturing Company, Inc.
f. Watts Drainage Products Inc.
g. Zurn Plumbing Products Group; Specification Drainage Operation.
h. Wade.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: as required to match connected piping.
5. Closure: Countersunk or raised-head, 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.

2.2 FLOOR DRAINS

A. Floor Drains: As scheduled on drawings.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

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.

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: 4-inch- minimum water seal.
b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

C. 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.

2.4 Vent Caps:

A. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.

B. Size: Same as connected stack vent or vent stack.

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 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. Use NPS 4 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 for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. 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 or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch 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.

F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

G. Install deep-seal traps on floor drains and other waste outlets, if indicated.

H. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

J. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

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 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.

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 221319

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data for each type of plumbing fixture, including trim, fittings, accessories, appliances, appurtenances, equipment, and supports.
2. Documentation indicating flow and water consumption requirements.

1.2 WARRANTY

A. In addition to (1) year general warranty, provide following guarantees:

1. Fixture finish shall be guaranteed against cracking of finish for (1) year from date of acceptance. If such defect develops during guarantee period, Contractor shall replace defective fixture with new fixture of same manufacturer without additional cost to Owner.
2. Electric Water Cooler Compressors: (5) years total.

PART 2 - PRODUCTS

2.1 PER FIXTURE SCHEDULE LISTED ON DRAWINGS

A. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" and "Americans with Disabilities Act" for plumbing fixtures for people with disabilities.

B. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

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. All ADA toilets and wall carriers to be rated for 1,000 pound static force.

PART 3 - EXECUTION

3.1 INSTALLATIONS

A. Install fitting insulation kits on fixtures for people with disabilities.

B. Install fixtures with flanges and gasket seals.

C. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

D. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

E. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.

F. Fasten floor-mounted fixtures to substrate. Fasten fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.

G. Fasten wall-mounted fittings to reinforcement built into walls.

H. Fasten counter-mounting plumbing fixtures to casework.

I. Secure supplies to supports or substrate within pipe space behind fixture.

J. Set shower receptors and mop basins in leveling bed of cement grout.

K. Install individual supply inlets, supply stops, supply risers, and tubular brass traps with cleanouts at fixture.

L. Install water-supply stop valves in accessible locations.

M. Install traps on fixture outlets. Omit traps on fixtures having integral traps. Omit traps on indirect wastes unless otherwise indicated.

N. Install disposers in sink outlets. Install switch where indicated, or in wall adjacent to sink if location is not indicated.

O. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Connect inlet hose to dishwasher and outlet hose to disposer.

P. Install escutcheons at wall, floor, and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons where required to conceal protruding pipe fittings.

Q. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

R. Install piping connections between plumbing fixtures and piping systems and plumbing equipment.

S. Ground equipment.

END OF SECTION 224000

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hangers and Supports for Plumbing Piping Equipment:

1. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

   a. Design supports for multiple pipes capable of supporting combined weight of supported systems, and system contents.
   b. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   c. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

2.2 SLEEVES AND SLEEVE SEALS

A. Galvanized-Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

B. PVC Pipe: ASTM D 1785, Schedule 40.

C. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

D. Modular rubber sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

E. Stack-Seal Fitting: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

2.4 ESCUTCHEONS AND FLOOR PLATES

A. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

B. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

C. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

2.5 PRESSURE GAGES AND TEST PLUGS

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Sealed Open-front, pressure relief; cast aluminum; 4-1/2-inch nominal diameter.
3. Movement: Mechanical, with link to pressure element and connection to pointer.
4. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
5. Pointer: Dark-colored metal.
6. Window: Plastic.
7. Ring: Metal.
8. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Test Plug: Corrosion-resistant brass or stainless-steel body with two self-sealing rubber core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping. Minimum pressure and temperature rating of 500 psig at 200 deg F.

2.6 HANGERS AND SUPPORTS FOR HVAC

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 carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

C. Fastener Systems:

1. Verify suitability of fasteners in this article for use in lightweight concrete or concrete slabs less than 4 inches thick.
2. 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.
3. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated 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.

D. Miscellaneous Materials:

1. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
2. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

   a. Properties: Nonstaining, noncorrosive, and nongaseous.
   b. Design Mix: 4000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 GENERAL PIPING INSTALLATIONS

A. Install piping free of sags and bends.

B. Install fittings for changes in direction and branch connections.

C. Sleeves:

1. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
2. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

   a. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

3. Install stack-sleeve fittings in new slabs as slabs are constructed.
4. Exterior Wall, Pipe Penetrations: Mechanical sleeve seals installed in steel or cast-iron pipes for wall sleeves.
5. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078446 "Penetration Firestopping."

D. Sleeve-Seal-System Installation:

1. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
2. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

E. Escutcheons & Floor Plates:

1. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
2. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
3. Install floor plates for piping penetrations of equipment-room floors.
4. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

F. Install unions at final connection to each piece of equipment.

G. Install dielectric unions and flanges to connect piping materials of dissimilar metals in gas piping.

H. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals in water piping.

3.2 HANGERS AND SUPPORTS

A. Comply with MSS SP-69 and MSS SP-89. Install building attachments within concrete or to structural steel.

B. Install hangers and supports to allow controlled thermal and seismic movement of piping systems.

C. Install powder-actuated fasteners and mechanical-expansion anchors in concrete after concrete is cured. Do not use in lightweight concrete or in slabs less than 4 inches thick.

D. Load Distribution: Install hangers and supports so piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification 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.
2. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
3. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
4. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
5. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.

F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

3.3 GENERAL EQUIPMENT INSTALLATIONS

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, unless otherwise indicated.

C. Install mechanical 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.

E. Mix and install grout for pump and other equipment base plates, and anchors. Place grout, completely filling equipment bases.

END OF SECTION 230500

SECTION 230525 – ROOF CURBS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Qualitative requirements for roof curbs for equipment mounting and piping penetrations.

1.2 SUBMITTALS

A. Submittals are required and shall include material, quantities, and dimensions.

1.3 COMPONENTS

A. Roof Curbs

1. Roof curb shall be constructed of galvanized steel with welded corner beams and pressure treated 2 by 2 wood nailer.
2. Curbs shall be preinsulated with 1-1/2 inch rigid insulation.
3. Top of curb shall set dead level.
4. Base of curb shall match roof slope.
5. Provide 18 inches for kitchen hood exhaust fans.

B. Box Curb

1. Box section curbs shall be constructed of welded, heavy gauge galvanized steel with mitered and welded corners, integral base plate, and pressure treated wood nailer.
2. Curb shall be insulated with minimum 1-1/2 inch rigid insulation.

C. Equipment Support

1. Rails shall be 18 gauge welded galvanized steel with a welded galvanized counterflashing. Unit to have integral base plate, and 2 by 4 pressure treated wood nailer.
2. Rails to be of the length and strength required to support the specified equipment.
3. Equipment rails shall be internally reinforced to conform with manufacturers load bearing factors.

D. Pipe Roller Supports

1. Pipe support shall be constructed from heavy gauge galvanized steel with continuous welded corner seams, 2 by 4 treated wood nailer, galvanized steel counterflashing and galvanized steel channel track.

E. Pipe Curbs

1. Pipe curb shall consist of a heavy gauge galvanized steel roof curb of unitized construction, with integral base plate, 3 pound density insulation, and 2 by 2 nailer. Curb shall be covered with a thermoplastic cover, fastening screws, graduated step boots with stainless steel adjustable clamps.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Roof curbs and equipment rails shall be mounted with top dead level, properly anchored to the deck.

B. Roof curbs for metal roof systems shall be provided by the metal roof system manufacturer.

END OF SECTION 230525

SECTION 230529 – HANGERS AND SUPPORTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

1.2 REFERENCES

A. American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)

1. ANSI/ASME B31.1, Power Piping, (SI Edition).

B. American Society for Testing and Materials (ASTM)

1. ASTM A125, Specification for Steel Springs, Helical, Heat-Treated.
2. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
3. ASTM A563, Specification for Carbon and Alloy Steel Nuts.

C. Factory Mutual (FM)

D. Health Canada / Workplace Hazardous Materials Information System (WHMIS).

1. Materials Safety Data Sheets (MSDS).

E. Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

1. MSS SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
2. ANSI/MSS SP-69, Pipe Hangers and Supports - Selection and Application.
3. MSS SP-89, Pipe Hangers and Supports - Fabrication and Installation Practices.

F. Underwriter's Laboratories of Canada (ULC)

1.3 SYSTEM DESCRIPTION

A. Design Requirements

1. Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
2. Base maximum load ratings on allowable stresses prescribed by MSS SP58 or ASME B31.1.

3. Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
4. Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
5. Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58.

B. Performance Requirements

1. Design supports, platforms, catwalks, hangers, to withstand seismic events for location as per the National Building Code

1.4 SUBMITTALS

A. Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

B. Shop drawings: submit drawings stamped and signed for approval by Owner’s Representative.

C. Submit shop drawings and product data for following items:

1. Bases, hangers and supports.
2. Connections to equipment and structure.
3. Structural assemblies.

D. Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

1. Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
2. Instructions: submit manufacturer's installation instructions.

a. Owner’s Representative will make available 1 copy of systems supplier's installation instructions.

E. Closeout Submittals:

1. Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals

1.5 QUALITY ASSURANCE

A. Health and Safety:

1. Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing, shipping, handling and unloading:

1. Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
2. Deliver, store and handle materials in accordance with manufacturer's written instructions.

B. Waste Management and Disposal:

1. Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

A. Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP-58 and SP-89.

2.2 PIPE HANGERS

A. Finishes:

1. Pipe hangers and supports: galvanized painted with zinc-rich paint after manufacture.
2. Use electro-plating galvanizing process or hot dipped galvanizing process.
3. Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

B. Upper attachment structural: Suspension from lower flange of I-Beam.

1. Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

a. Rod: 9 mm UL listed, 13 mm FM approved.

2. Cold piping NPS 2 1/2 or greater, hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed, FM approved where required to MSS-SP58 and MSS-SP69.

C. Upper attachment structural: Suspension from upper flange of I-Beam.

1. Cold piping NPS 2 maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed FM approved where required to MSS SP69.

2. Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved where required.

D. Upper attachment to concrete.

1. Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
2. Concrete inserts: wedge shaped body with knockout protector plate UL listed FM approved where required to MSS SP-69.

E. Shop and field-fabricated assemblies.

1. Trapeze hanger assemblies: MSS SP-89.
2. Steel brackets: MSS SP-89.
3. Sway braces for seismic restraint systems: to MSS SP-89.

F. Hanger rods: threaded rod material to MSS SP-58.

1. Ensure that hanger rods are subject to tensile loading only.
2. Provide linkages where lateral or axial movement of pipework is anticipated.
3. Do not use 22 mm or 28 mm rod.

G. Pipe attachments: material to MSS SP-58.

1. Attachments for steel piping: carbon steel galvanized.
2. Attachments for copper piping: copper plated black steel.
3. Use insulation saddles for hot pipework.
4. Oversize pipe hangers and supports for insulated pipes.

H. Adjustable clevis: material to MSS SP-69, UL listed FM approved, where required clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

1. Ensure "U" has hole in bottom for rivetting to insulation shields.

I. Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP-69.

J. U-bolts: carbon steel to MSS SP-69 with 2 nuts at each end to ASTM A563.

1. Finishes for steel pipework: galvanized.
2. Finishes for copper, glass, brass or aluminum pipework: black with formed portion plastic coated or epoxy coated.

K. Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP-69.

2.3 RISER CLAMPS

A. Steel or cast iron pipe: galvanized black carbon steel to MSS SP-58, type 42, UL listed FM approved where required.

B. Copper pipe: carbon steel copper plated to MSS SP-58, type 42.

C. Bolts: to ASTM A307.

D. Nuts: to ASTM A563.

2.4 INSULATION PROTECTION SHIELDS

A. Insulated cold piping:

1. 64 kg/m^3 density insulation plus insulation protection shield to: MSS SP-69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

B. Insulated hot piping:

1. Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP-69.

2.5 CONSTANT SUPPORT SPRING HANGERS

A. Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/- 5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).

B. Load adjustability: 10 % minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

C. Provide upper and lower factory set travel stops.

D. Provide load adjustment scale for field adjustments.

E. Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.

F. Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.6 VARIABLE SUPPORT SPRING HANGERS

A. Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

B. Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

C. Variable spring hanger to be complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.

D. Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.7 EQUIPMENT SUPPORTS

A. Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

A. Provide templates to ensure accurate location of anchor bolts.

2.9 HOUSE-KEEPING PADS

A. For base-mounted equipment: Concrete, at least 100 mm high, 50 mm larger all around than equipment, and with chamfered edges.

B. Concrete: to Section 03 30 00 - Cast-in-place Concrete by Division 3.

2.10 OTHER EQUIPMENT SUPPORTS

A. From structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings.

B. Submit structural calculations with shop drawings.

PART 3 - EXECUTION

3.1 MANUFACTURER’S INSTRUCTIONS

A. Compliance: comply with manufacturer’s written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

A. Install in accordance with:

1. Manufacturer's instructions and recommendations.

B. Vibration Control Devices:

1. Install on piping systems at pumps, boilers, chillers, cooling towers, elsewhere as indicated.

C. Clamps on riser piping:

1. Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
2. Bolt-tightening torques to be to industry standards.
3. Steel pipes: Install below coupling or shear lugs welded to pipe.
4. Cast iron pipes: Install below joint.

D. Clevis plates:

1. Attach to concrete with 4 minimum concrete inserts, one at each corner.

E. Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

F. Use approved constant support type hangers where:

1. Vertical movement of pipework is 13 mm or more,
2. Transfer of load to adjacent hangers or connected equipment is not permitted.

G. Use variable support spring hangers where:

1. Transfer of load to adjacent piping or to connected equipment is not critical.
2. Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

A. Plumbing piping: most stringent requirements of Canadian Plumbing Code

B. Fire protection: to applicable fire code.

C. Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.

D. Copper piping: up to NPS 1/2: every 1.5 m.

E. Hydronic, steam, condensate, rigid, and flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

Maximum Pipe Size: NPS	Maximum Spacing: Steel	Maximum Spacing: Copper
up to 1-1/4	2.1 m	1.8 m
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m
3	3.6 m	3.0 m
3-1/2	3.9 m	3.3 m

Maximum Pipe Size: NPS	Maximum Spacing: Steel	Maximum Spacing: Copper
4	4.2 m	3.6 m
5	4.8 m	
6	5.1 m	
8	5.7 m	
10	6.6 m	
12	6.9 m	

F. Within 300 mm of each elbow.

G. Pipework greater than NPS 12: to MSS SP69.

3.4 HANGER INSTALLATION

A. Install hanger so that rod is vertical under operating conditions.

B. Adjust hangers to equalize load.

C. Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members, comprised of angel iron or c-channel.

3.5 HORIZONTAL MOVEMENT

A. Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

B. Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

A. Adjust hangers and supports:

1. Ensure that rod is vertical under operating conditions.
2. Equalize loads.

B. Adjustable clevis:

1. Tighten hanger load nut securely to ensure proper hanger performance.
2. Tighten upper nut after adjustment.

C. C-clamps:

1. Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

D. Beam clamps:

1. Hammer jaw firmly against underside of beam.

END OF SECTION 230529

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each product indicated.
2. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
3. Welding certificates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Basic Wind Speed: 100 MPa.
2. Building Classification Category: III.
3. Minimum 10 lb/sq. ft. 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.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: B.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.

   a. Component Importance Factor: 1.25.
   b. Component Response Modification Factor: 2.5.
   c. Component Amplification Factor: 2.5.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 30%.
4. Design Spectral Response Acceleration at 1-Second Period: 10%.

D. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2.2 VIBRATION ISOLATORS

A. 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 neoprene.

B. 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.

   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.

C. 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.

D. Spring Isolators: 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-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
   6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. Restrained Spring Isolators: 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-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.

F. Elastomeric Hangers: 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.

G. Spring Hangers: 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.

H. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum of 1/2-inch-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 and for equal resistance in all directions.

2.3 SEISMIC-RESTRAINT DEVICES

A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

B. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

C. Restraint Cables: ASTM A 603 galvanized- steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

PART 3 - EXECUTION

3.1 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

E. 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.

F. 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. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Remove and replace malfunctioning units and retest as specified above.

C. Prepare test and inspection reports.

3.3 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 active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.4 HVAC VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

A. Supported or Suspended Equipment: Fan coils, duct, hydronic piping

1. Equipment Location
2. Base Type: Cables.
3. Component Importance Factor: 1.25.
4. Component Response Modification Factor: 2.5.
5. Component Amplification Factor: 2.5.

END OF SECTION 230548

SECTION 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents:

1. Drawings and general provisions of the Subcontract apply to this Section.
2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes:

1. Identify all installed mechanical distribution piping, mechanical equipment and components.
2. Cast-in-place concrete.

C. Related Sections:

1. Division 01 Section "General Requirements."
2. Division 01 Section "Special Procedures."
3. Division 09 Section "Painting" for identification painting.

1.2 REFERENCES

A. General:

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.
4. Refer to Division 23 Section "Common Results for HVAC" for codes and standards, and other general requirements.

B. ANSI/ASME –American National Standards Institute/Society of Mechanical Engineers:

1. ASNI/ASME A 13.1 Scheme for the identification of piping systems

1.3 SUBMITTALS

A. Submit under provisions of Division 23 Section "Common Results for HVAC, Review of Materials" and Division 01 Section "General Requirements."

B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Submit valve database as per Part 3.05 -Stenciling and Identification, D.3 - Valve Tags.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. W. H. Brady, Seton or Almatek products.

B. No substitutions.

2.2 MATERIALS

A. Color coding: ANSI/ASME A13.1 unless specified otherwise.

B. Plastic nameplates: laminated two-layer plastic with engraved black letters on light, contrasting background color.

C. Plastic tags: laminated three-layer (double-sided) plastic with engraved black letters on light, contrasting background color. Tag size at least 1-1/2 inch (38 mm) diameter.

D. Stencils: with clean-cut symbols and letters of following size:

Outside Diameter of Insulation or Pipe	Color Field Length	Letter Height
¾ to 1-1/4 inches (9.5 to 31.7 mm)	8 inches (200 mm)	½ inch (13 mm)
1-1/2 to 2 inches (38.1 to 50.8 mm)	8 inches (200 mm)	¾ inch (20 mm)
2-1/2 to 2 inches (63.5 to 50.8 mm)	12 inches (300 mm)	1 ¼ inch (32 mm)
8 to 10 inches (203.2 to 254 mm)	24 inches (600 mm)	2 ½ inch (64 mm)
Over 10 inches (254 mm)	32 inches (800 mm)	3 inches (75 mm)
Ductwork and equipment	---	2 ½ inch (64 mm)

E. Stencil paint: semi-gloss enamel; in accordance with Division 09 Section "Painting".

F. Plastic pipe markers: factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.

1. Special gases shall be identified using markers with yellow background and black letters, direction arrow, and full chemical names and symbols.

G. Plastic-tape pipe markers: flexible, vinyl-film tape with pressure-sensitive adhesive backing and printed markings.

H. Equipment tags: Metal tags, Almetek TH-9A with 500-series consisting of Almetek industries 9-character aluminum holder #TH-9A with 500-series characters, black on yellow background. Format is 2 characters for building # (15), space, 2 or 3 characters for equipment type (AC, AHU, etc.), space, three-digit equipment number (001, etc.). These tags can be ordered in parts and site-assembled, or pre-assembled from the factory. Attachment is by a pair of rivets, screws, or bolts onto the equipment to be identified; for water meters and similar equipment installed in piping, a pair of chains can be used for attachment.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive of identification materials.

B. Prepare surfaces in accordance with Division 09 Section "Painting" for stencil painting.

3.2 INSTALLATION

A. Plastic nameplates: install with corrosion-resistant mechanical fasteners, or adhesive.

B. Plastic tags: install with corrosion-resistant chain.

C. Stencil painting: apply in accordance with Division 09 Section "Painting".

D. Plastic pipe markers: install in accordance with manufacturer's instructions.

E. Plastic-tape pipe markers: install completely around pipe in accordance with manufacturer's instructions.

F. Underground plastic pipe markers: install 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.

G. Equipment tags: Install with corrosion-resistant mechanical fasteners.

3.3 IDENTIFICATION SCHEDULE

A. Equipment: identify air-handling units, pumps, heat-transfer equipment, tanks, boilers, blowers, and water-treatment devices, etc (see mechanical and plumbing schedules) with equipment tags per Section 2.2H. Small devices, such as VAV boxes and VFD's, may be identified with plastic tags.

B. Controls: identify control panels and major control components outside of panels with plastic nameplates.

C. Valves: identify valves in main and branch piping with tags.

D. Piping: identify piping, concealed or exposed, with stenciled painting. Tags may be used on small diameter piping. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not more than 20 feet (6 m) apart on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

E. Ductwork: identify ductwork with stenciled painting. Identify as to air-handling unit number, and area served. Locate identification at air-handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

3.4 VALVE DATABASE

A. Provide specified valve database.

3.5 STENCILING AND IDENTIFICATION

A. Stencil each piece of new and existing equipment including pumps, fans, tanks, etc., with the equipment tags scheduled on the drawings and per Part 2 above.

1. Stencil each duct leaving the mechanical room indicating fan unit, area(s), direction of flow, or room(s) served.
2. Stencil each duct branch leaving an air shaft at each floor with fan number, and identify it as a supply, exhaust, or return duct, and indicate direction of air flow.

B. Post a framed and typewritten schedule of all stencils, pipe markers, and valve tags, used, with identification, shall be framed and posted in the mechanical equipment room.

C. Identify all pipes with specified markers.

1. Install markers every 10 feet (3 m) on mains, at all branch take-offs and adjacent to valves and cocks.
2. Apply to all exposed pipes, pipes behind removable tile ceiling, pipes in concealed but accessible locations, such as behind access panels and at least once in each room.
3. Install pipe marker using pressure sensitive adhesive in accordance with the manufacturer's directions. The marker shall completely cover the circumference of the pipe and overlap itself.

D. Valve Tags: Provide numbered tags for main valves, branch valves, zone valves, shut-off valves, and balancing valves installed under this Contract, constructed of #18 gauge (1.02 mm) brass, circular, 1 ¼ inches (31.7 mm) in diameter, and with numbers cut in and blackened so as to be plainly discernible. Fasten tags to valve with brass links.

1. Valve numbers not required for valves obviously serving equipment such as air handler coils, reheat coil valves, and miscellaneous drains.
2. On the as-built drawings, indicate the location and number of each tagged valve.
3. Provide a computer file database in a form agreeable to the University, describing the valve, number, location , type of service normally “open” or “closed”, specific duty of each tagged valve, and manufacturer and model number.

E. Warning Sign at Fume Exhaust Plenums: Place warning sign on each fume exhaust plenum access - "WARNING. HAZARDOUS ATMOSPHERE INSIDE. USE BREATHING APPARATUS" when breaching containment.

F. Place warning signs on all machines driven by electric motors which are controlled by fully automatic starters. See Section 3320, Article 7, Subchapter 7, General Industry Safety Orders, Title 8, California Code of Regulations.

G. Fire dampers and fire smoke dampers: at each fire damper or fire smoke damper access panel, label "FIRE DAMPER" or “FIRE SMOKE DAMPER” in minimum 1 inch (25 mm) high letters. Fire smoke dampers shall be provided with tags to identify each fire smoke dampers with 2 lines as follows: the first line “FSD-NUMBER SEQUENCES-BLDG NUMBER” (e.g. FSD-001-15). The second line “ZONE FIRE ALARM-zone” that activates the damper (e.g. ZONE L1-03). Tags shall be engraved plastic with white letters on red background. Provide chart to University for approval.

H. Wherever charts, Shop Drawings, etc. Refer to specific room numbers, use room numbers that will be provided by the university rather than the room numbers indicated on the Drawings.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-flow air systems.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 SUBMITTALS

A. Certified TAB reports.

1.4 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.

B. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms approved by Architect and Commissioning Authority.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

E. All balancing shall be compliant with MN IMC 1346.309.

F. All startup and testing shall be compliant with MN IMC 107.2.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Certified TAB reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" Section 233116 "Nonmetal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine operating safety interlocks and controls on HVAC equipment.

L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:
   1. Permanent electrical-power wiring is complete.
   2. Hydronic systems are filled, clean, and free of air.
   3. Automatic temperature-control systems are operational.
   4. Equipment and duct access doors are securely closed.
   5. Balance, smoke, and fire dampers are open.
   6. Isolating and balancing valves are open and control valves are operational.
   7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
   8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. ASHRAE 62.1-2004 requires that ventilation systems be balanced according to ASHRAE 111, SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing," or equivalent at least to extent necessary to verify compliance with the standard.

B. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

D. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

E. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet flows with required fan flows.

B. Create schematic diagrams of each air systems' sections showing measurement locations.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
3. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

K. Adjust volume dampers for main duct, sub main ducts, and major branch ducts to indicated airflows within specified tolerances.

L. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.5 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, across each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

1. Measure flow through bypass.

3.6 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data

3.7 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

3.8 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.9 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of cur rent calibration.

B. Schedule:

1. Submit preliminary test and balance report to Engineer at least one week prior to Owner training for installed equipment.
2. Submit certified test and balance report(s) to be bound into or included with delivery of Owner’s Operation and Maintenance manuals.

C. Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Field test and start-up reports prepared by system and equipment installers.

D. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

F. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.

4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

3.10 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230713 – DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:

   a. Mineral/glass fiber.

2. Fire-rated insulation systems.
3. Adhesives.
4. Mastics.
5. Sealants.
6. Tapes.
7. Fasteners.
8. Corner angles.

B. Related Sections:

1. Section 230716 "HVAC Equipment Insulation."
2. Section 230719 "HVAC Piping Insulation."
3. Section 233113 "Metal Ducts" for duct liners.

1.2 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing 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 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.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Product data.
2. Field quality-control test reports.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation 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. 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 III with factory-applied FSK jacket Type III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

a. CertainTeed Corp.; SoftTouch Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Friendly Feel Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; SOFTR All-Service Duct Wrap.

G. 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 FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

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.

H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Aeroflex USA, Inc.; Aerocel.
   b. Armacell LLC; AP Armaflex.
   c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

2. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
3. All fitting must be must be factory fabricated, not field fabricated fitting allowed.

2.2 PIPES, TUBES, AND FITTINGS

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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
   b. Eagle Bridges - Marathon Industries; 225.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
   d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive 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."

C. 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 products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
   b. Eagle Bridges - Marathon Industries; 225.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
   d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive 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."

D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Aeroflex USA, Inc.; Aeroseal.
   b. Armacell LLC; Armaflex 520 Adhesive.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
   d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive 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."

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 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 use on below ambient services.

1. Products: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
   b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, 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, 58 percent by volume and 70 percent by weight.
5. Color: White.
6. Color: White.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
   b. Eagle Bridges - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
   d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants 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."

2.5 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. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.6 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 products by one of the following (Substitutions: See Section 016000 – Product Requirements):

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
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 products by one of the following (Substitutions: See Section 016000 – Product Requirements):

a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 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.

2.7 SECUREMENTS

A. Aluminum Bands: 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 seal or closed seal.

1. Products: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

B. Insulation Pins and Hangers:

1. 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 products by one of the following (Substitutions: See Section 016000 – Product Requirements):

1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
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: 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.

2. 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 products by one of the following (Substitutions: See Section 016000 – Product Requirements):

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.

3. 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 products by one of the following (Substitutions: See Section 016000 – Product Requirements):

1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
2) GEMCO; Peel & Press.
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: Aluminum or 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.

4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-(0.41-mm-) thick, galvanized-steel, aluminum 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 products by one of the following (Substitutions: See Section 016000 – Product Requirements):

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.

5. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

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, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

a. C & F Wire.

2.8 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.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. 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.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. 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). 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, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. 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.

3.3 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 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.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: 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 Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: 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. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 INSTALLTION OF MINERAL-FIBER INSULATION

A. 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 one edge and

one 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 two 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.

B. 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 one edge and one 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 two 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.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

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. Clean all ductwork as recommend by manufacturer.
2. Install mitered sections of pipe insulation.
3. 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.

4. Install insulation to flanges as specified for flange insulation application.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. 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.

B. 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.

3.7 FINISHES

A. Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

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. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect/Engineer, 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.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 INSULATION SCHEDULE, GENERAL

A. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Factory-insulated access panels and doors.
5. Flexible connectors.

Table 1: Typical HVAC Equipment, Piping and Duct Insulation Applications

HVAC Systems	Insulation Types (1)	Density (lbs./cu.Ft.)	Insulation Thickness	Vapor Barrier Requirements (2)	Jacket Types (3)
Refrigerant Suction piping	FE	-	1 inch	no	AS, AL (out-doors)
Refrigerant Hot Gas piping	none	-	-	none	none
Refrigerant Liquid piping	none	-	-	none	none
Supply air ducts (concealed)	GF, PF duct wrap	1.5	1-1/2 inch	yes	FSK (4)
Supply air ducts (exposed)	GF, PF	3.0	1 inch	yes	FSK (4)
Return air ducts	(5)	-	-	-	-
Transfer air ducts	(5)	-	-	-	-
Exhaust ducts (all within 15'0" of exterior)	GF duct wrap	1.5	1-1/2 inch	yes	PF, FSK
Exterior piping	refer to application, increase thickness 1/2 inch			yes, SJ	AL or SS

(1) Key to Insulation Materials:

GF = glass or mineral fiber

CG = cellular glass

FE = flexible elastomeric foam, closed cell

PF = closed cell phenolic foam

CS = calcium silicate

HTGF = high temperature glass fiber

(2) Key to Vapor Barrier Requirements

yes = required

none = not required

(3) Key to Jacket Requirements:

AP = All purpose foil, scrim, kraft paper jacket (white)

FSK = Foil, scrim, kraft paper jacket with foil finish

PVC = PVC jacket

AL = Aluminum jacket

SS = Stainless steel jacket

GC = Canvas or glass cloth

(4) Glass cloth jacket and rigid board insula-tion
required in mechanical room and exposed ductwork
within 8 feet of floor.

SJ = continuous sealed joints required	(5) Refer to Section 233113 Metal Ducts for duct liner specification.

END OF SECTION 230713

SECTION 230719 - HVAC PIPING 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 insulating the following HVAC piping systems:

1. Condensate drain piping, indoors and outdoors.
2. Refrigerant suction and hot-gas piping, indoors and outdoors.

B. Related Sections:

1. Section 230713 "Duct Insulation."
2. Section 230716 "HVAC Equipment Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

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.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.4 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.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping 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.

1.6 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 "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation 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 Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

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. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.

c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

2.2 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 Adhesive: Comply with MIL-A-24179A, Type II, Class I.

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. Aeroflex USA, Inc.; Aeroseal.
   b. Armacell LLC; Armaflex 520 Adhesive.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
   d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive 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."

C. PVC Jacket Adhesive: Compatible with PVC jacket.

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 Corning Corporation; 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; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive 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."

2.3 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. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.4 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.

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.

2.5 FIELD-APPLIED JACKETS

A. 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, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems 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 thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. 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 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.

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 piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of 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- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

   a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, 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 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 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.
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 Section 078413 "Penetration Firestopping" for firestopping 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 Section 078413 "Penetration Firestopping."

3.5 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. Shape insulation at these connections by tapering it to and around the

connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with the 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.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with the 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.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.9 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 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.

3.10 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.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Elastomeric: 1/2 inches thick.

B. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 3/4 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Provide aluminum jacket covering on all suction piping.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 3/4 inch thick.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 3/4 inches thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 3/4 inches thick.

3.13 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. Piping, Concealed: (All piping to be concealed in surface mount piping chase)

1. None.

3.14 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, Concealed:

1. PVC 30 mils thick.
2. Aluminum, Smooth: 0.024 inch thick.

D. Piping, Exposed:

1. PVC: 40 mils thick.
2. Aluminum, Smooth with Z-Shaped Locking Seam: 0.024 inch thick.

END OF SECTION 230719

SECTION 230901 – TEMPERATURE CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes product, application, and installation provisions for controls and systems to automatically control operation of respective mechanical equipment and systems.

B. Design, furnish, install, test, and adjust a complete automatic temperature control system for mechanical equipment and systems as specified in this Section and respective complementary Sections.

C. Sequences of Operation are specified in Section 230993.

D. Provisions of Division 26 govern electrical work of this Section.

E. Power supply wiring from power source to power connection on controls and/or unit control panels and power supply wiring through line voltage controls to equipment will be provided as a part of Division 26 work.

1.2 PRODUCTS CONNECTED BUT NOT FURNISHED UNDER THIS SECTION

A. Connect control components factory supplied with respective equipment, unless directed otherwise for particular equipment.

1.3 SYSTEM DESCRIPTION

A. System: Control System, with required controls and devices (thermostats, control valves, dampers and operators, indicating devices, interface equipment, and other apparatus and accessories) required to automatically operate mechanical systems and equipment, and perform specified functions.

1.4 SUBMITTALS

A. Prior to commencing work, submit:

1. Product data and shop drawings for each type of control system component to be installed on this Project.
2. Shop Drawings: Include system drawings, wiring diagrams, complete operating data, and written detailed operational description of sequences.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 230500.

B. Include systems descriptions, set points, and controls settings and adjustments.

C. Include recommended inspection intervals, cleaning methods, cleaning materials, and calibration tolerances.

1.6 PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Section 230500.

B. Accurately record actual setpoints and settings of controls, including changes to sequences made after submission of shop drawings.

C. Submit detailed system start-up procedure and test report for each system.

D. Submit field reports indicating operating conditions after detailed check out of systems.

1.7 QUALITY ASSURANCE

A. All Control Products: Furnished by the same manufacturer; standard cataloged products, with repair parts and replacement units readily available from stock.

B. System Installation: Performed by personnel in the direct employ of the manufacturer, thoroughly trained in equipment and installation requirements of pneumatic control systems.

C. Products and Installation: In accordance with acceptable reviewed submittals.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site, properly store, and protect under applicable provisions of Section 230500.

1.9 DEMONSTRATION OF OPERATION

A. After controls are installed and adjusted, demonstrate to Architect’s representative that all sequences are functioning correctly.

1.10 TRAINING OF OWNER’S PERSONNEL

A. Provide a minimum of two (2) hours of in-house training to Owner’s designated personnel.

1. Demonstrate starting, running and stopping of all equipment and explain step-by-step operation of each unit and system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Wall mount, temperature, CO2, and humidity sensors with display thermostats, 7-day programmable w/battery backup, LED display.

PART 3 - EXECUTION

3.1 VERIFICATION OF CONDITIONS

A. Verify that systems are ready to receive control work.

B. Prior to rough-in, check drawings and room details and coordinate locations of control devices (thermostats, humidistats, etc.) with other installations (light switches, equipment controls, etc.).

C. Commencing installation will be understood to mean that Installer accepts existing conditions.

3.2 INSTALLATION, GENERAL

A. No portions of work shall commence until data and shop drawing submission has been reviewed and adjudged acceptable by Architect/Engineer. All work shall be in accordance with acceptable reviewed submittals.

B. Supervise installation of equipment which is furnished for installation by others.

C. Check, calibrate and adjust entire automatic control system and place it into satisfactory operating condition subject to approval of the Architect.

3.3 ELECTRICAL WIRING

A. Furnish and install all additional wiring not shown on Electrical drawings required to connect electrical control devices furnished as part of the Temperature Control work; control wiring required to accomplish respective sequences of operation (freeze-stats, limit controls, relays, flow and pressure switches, etc.); and control wiring between controls, indicating devices, and unit control panels.

B. Applicable provisions of Division 26 govern electrical work.

C. Temperature control wiring run to items equipped with a disconnect, shall be arranged so control circuit will be broken when disconnect is pulled. All voltages must be disconnected within the enclosures.

END OF SECTION 230901

SECTION 230993 – SEQUENCES OF OPERATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes sequences of operation, for mechanical systems and equipment.

1. Strictly adhere to specified sequences for respective equipment and systems.
2. Furnish all devices required to accomplish respective operating sequences, whether specified or not.
3. Devices not furnished by respective equipment manufacturer shall be supplied by the contractor.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (CONTROLS SEQUENCES)

3.1 AHU, CU

A. AHU fan shall operate continuously during occupied mode and cycle during unoccupied.

B. AHU and CU compressor shall stage to offset zone heat loss or gain.

C. Provide O.A. intake with motor operated damper to each AHU to automatically modulate open/close with CO2 carbon dioxide sensor operation.

D. Provide for 2-stage heating and 2-stage cooling control.

E. Provide for alarm notification for low space temperature.

3.22 START-UP / TESTING

A. The Building Energy Management System shall be started up in phases agreed to by the Owner.

B. Prior to testing and verifying proper system operation, Contractor shall furnish the Owner and Engineer, for acceptance two (2) copies each of the start-up/testing procedure proposed. Owner and Engineer will review the check-out procedure prior to start-up/testing.

C. After the procedure is reviewed and after installation is complete and systems are ready to be placed into regular service, Contractor shall inform the Owner of this fact in writing.

D. Contractor shall agree on a start-up date with Owner and Engineer.

E. During start-up period Contractor shall have on-site qualified field technicians to place the system in operation, marking such tests, adjustments and changes as may be found necessary to insure successful operation of the installed equipment and systems. All tests shall be documented by the Contractor and certified, verifying that the tests have been performed and that all deficiencies have been corrected. All testing must be performed and all deficiencies corrected to Owner's satisfaction.

3.23 TRAINING

A. At the completion of the project, contractor shall provide 4 hours of training.

1. Demonstrate starting, running and stopping of all equipment and explain step-by-step operation of each unit and system.

END OF SECTION 230993

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIRMENTS

A. Comply with ASME B31.5, "Refrigerant Piping," and with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

2.2 TUBES AND FITTINGS

A. Copper Tube: ASTM B 88, Types K and L and ASTM B 280, Type ACR.

B. Wrought-Copper Fittings and Unions: ASME B16.22.

C. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

D. Brazing Filler Metals: AWS A5.8.

2.3 VALVES AND SPECIALTIES

A. Thermostatic Expansion Valve: Comply with ARI 750; forged brass or steel body, stainless-steel internal parts, copper tubing filled with refrigerant charge for 40 deg F suction temperature and 240 deg F operating temperature.

B. Solenoid Valves: Comply with ARI 760; 240 deg F temperature rating, 400-psig working pressure, 240 deg F operating temperature; and 24-V normally closed holding coil.

C. Strainers: Welded steel with corrosion-resistant coating and 100-mesh stainless-steel screen with socket ends; 500-psig working pressure and 275 deg F working temperature.

D. Moisture/Liquid Indicators: 500-psig operating pressure, 240 deg F operating temperature; with replaceable, polished, optical viewing window and color-coded moisture indicator.

E. Filter Dryers: 500-psig operating pressure; 240 deg F operating temperature; with replaceable core kit, gaskets, and cartridge.

F. Mufflers: Welded steel with corrosion-resistant coating and socket ends; 500-psig operating pressure; 240 deg F operating temperature.

G. Refrigerant: ASHRAE 34, R-410A.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with requirements in Section 230500 "Common Work Results for HVAC" for basic piping installation requirements.

B. Install wall penetration system at each pipe penetration through foundation wall. Make installation watertight. Comply with requirements in Section 230500 "Common Work Results for HVAC" for wall penetration systems.

C. Install refrigerant piping and charge with refrigerant according to ASHRAE 15.

D. Belowground, install copper tubing in PVC conduit. Vent conduit outdoors.

E. Insulate suction lines to comply with Section 230700 "HVAC Insulation."

F. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

G. Install solenoid valves upstream from each thermostatic expansion valve. Install solenoid valves in horizontal lines with coil at top.

H. Install thermostatic expansion valves as close as possible to distributors on evaporator coils.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to solenoid valves, thermostatic expansion valves, and compressors unless they are furnished as an integral assembly for device being protected:

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

3.2 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

B. Hot-Gas and Liquid Lines: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

END OF SECTION 232300

SECTION 233113 – METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. 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, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 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.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Product data.

PART 2 - PRODUCTS

2.1 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."

2.2 ROUND DUCT 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 (Substitutions: See Section 016000 – Product Requirements):

   a. Lindab Inc.
   b. McGill AirFlow LLC.
   c. SEMCO Incorporated.
   d. Sheet Metal Connectors, Inc.
   e. Spiral Manufacturing Co., Inc.

B. 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 in Diameter: Flanged.

C. 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 in diameter with butt-welded longitudinal seams.

D. 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."

2.3 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. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; galvanized.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 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 one of the following (Substitutions: See Section 016000 – Product Requirements):

   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 at 75 deg F mean temperature.
   b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

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- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches 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. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
7. 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 or where indicated.

8. Secure insulation between perforated 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.

    a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

9. 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.

2.5 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: 3 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

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, 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. 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.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

2.6 HANGARS 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, "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.

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, 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.

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.

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.

C. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

D. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 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."

3.4 HANGAR 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 thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "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 of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

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.

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.

3.5 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.

3.6 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.

B. Supply Ducts:

1. Ducts Connected to Self-Contained Units, Heat Pumps, and Terminal Units:

   a. Pressure Class: Positive 3-inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 6.
   d. SMACNA Leakage Class for Round and Flat Oval: 3.

2. Ducts connected to RTUs

   a. Pressure Class: Positive 5–inch wg.

C. Return Ducts:

1. Ducts Connected to Self-Contained Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting Air:

a. Pressure Class: Negative 2-inch wg.
b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

F. Liner:

1. Transfer Ducts: Fibrous glass, Type I, 1/2 inch thick.

G. 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 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:

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 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 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 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 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 or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm 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 and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

H. 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.

2. Round: 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 permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 – AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manual volume dampers.
2. Fire dampers.
3. Radiation dampers.
4. Smoke dampers.
5. Combination fire/smoke dampers.
6. Flange connectors.
7. Turning vanes.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

1.2 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.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Product data.
2. Product certificates.
3. Field quality-control test reports.
4. Wiring Diagrams.
5. Warranty: Sample of warranty.

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.
2. Exposed-Surface Finish: Mill phosphatized.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: ect to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   a. Air Balance Inc.; a division of Mestek, Inc.
   b. Cesco Products; a division of Mestek, Inc.
   c. Flexmaster U.S.A., Inc.
   d. Ruskin Company.

2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Frames:

   a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized-steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.
7. Bearings:
    a. Molded synthetic.
    b. Dampers in ducts with pressure classes of 3-inch wg 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.

2.3 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):
    1. Greenheck Fan Corporation.
    2. Ruskin Company.
    3. Nailor.
    4. Pottorff.

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Fire Rating: 1-1/2 hours.

D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
    1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
    2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.4 RADIATION DAMPER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

1. Greenheck Fan Corporation.
2. Ruskin Company.
3. Nailor.
4. Pottorff.
5. Panasonic.

B. Type: Dynamic; rated and labeled according to UL 555, UL555C and NFPA 90.

C. Fire Rating: 2 hours, for use in UL floor/ceiling assembly.

D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners. Contractor shall verify mounting with ceiling and structure type.

E. Mounting Orientation: Horizontal ceiling mounted.

F. Blades: Hindged door, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

G. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

H. Unit shall be compatible with scheduled ceiling mounted exhaust fan.

2.5 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Pottorff.
6. Ruskin Company.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel, with mechanically attached corners and mounting flange.

E. Smoke Detector: Provide and wired by division 26.

F. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- (0.85-mm-)] thick, galvanized sheet steel.

G. Leakage: Class I.

H. Rated pressure and velocity to exceed design airflow conditions.

I. Mounting Sleeve: Factory-installed, 0.05-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

J. Damper Motors: Two-position action.

K. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "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 Section 230900 "Instrumentation and Control for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 115 V, single phase, 60 Hz.

L. Accessories:

1. Auxiliary switches for position indication.
2. Test and reset switches, remote mounted.

2.6 COMDINATION FIRE/SMOKE DAMPERS

A. Retain "Manufacturers" Paragraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Ruskin Company.
4. Nailor.
5. Pottorff.

C. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

D. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

E. Fire Rating: 1-1/2 hours.

F. Frame: Multiple-blade type Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch-(0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

G. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

H. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

I. Smoke Detector: Provide and wired by division 26.

J. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

K. Leakage: Class I class.

L. Rated pressure and velocity to exceed design airflow conditions.

M. Mounting Sleeve: Factory-installed, 0.052-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

N. Damper Motors: Two-position action.

O. 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 23 Section "Instrumentation and Control for HVAC." Division 26 Sections.
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.

4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 115 V, single phase, 60 Hz.

P. Accessories:

1. Auxiliary switches for position indication.
2. Test and reset switches, remote mounted.

Q. Accessories:

1. Auxiliary switches for position indication.
2. Test and reset switches, remote mounted.

2.7 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by 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: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.8 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

1. Ductmate Industries, Inc.
2. METALAIRE, Inc.
3. SEMCO Incorporated.

4. 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 wall.

2.9 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Greenheck Fan Corporation.
5. Ward Industries, Inc.; a division of Hart & Cooley, 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 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 Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two com-

pression latches with outside and inside handles.

2.10 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

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. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

2.11 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. Ventfabrics, Inc.
5. 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 two 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 weather-proof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
2. Tensile Strength: 530 lbf/inch (93 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).

2.12 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

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, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 175 deg F.

2.13 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.

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 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.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated.

F. Install fire dampers according to UL listing.

G. Install radiation dampers according to UL listing.

H. Install smoke dampers according to UL listing.

I. Install fire/smoke dampers according to UL listing.

J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
2. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire 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.
3. Upstream from turning vanes.
4. Elsewhere as indicated.

K. Install access doors with swing against duct static pressure.

L. Install flexible connectors to connect ducts to equipment.

M. Connect terminal units to supply ducts directly. Do not use flexible ducts to change directions.

N. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

O. Connect flexible ducts to metal ducts with liquid adhesive plus tape.

P. Install duct test holes where required for testing and balancing purposes.

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 and fire/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 233300

SECTION 233400 – FANS, EXHAUSTERS, AND VENTILATORS, GENERAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general provisions, product requirements, and specifications common to Fans, Exhausters, Ventilators, and accessories.

B. Particular fan, exhauster, and ventilator types are included in respective complementary Sections immediately following this Section. Refer to Project Manual "Table of Contents" for respective product Section titles. If a particular product is indicated on Drawings and not included in a complementary Section in Project Manual, applicable provisions of this Section and construction and features of product referenced on Drawings shall govern respective product furnished for the application.

C. Applicable general provisions in this Section govern fans, exhausters, and ventilators included in respective complementary Sections the same as if repeated in respective Sections.

D. Fans, exhausters, and ventilators furnished as a part of the work of this Project shall comply with applicable provisions of this Section, specifications in respective fan, exhauster, and ventilator type Sections, and schedules and notes on Drawings. Specifications for particular type units have precedence over similar general provisions of this Section.

E. Applicable provisions of Sections 230500 and respective related product and system Sections, govern work of this Section and respective complementary Sections.

F. Roof Curbs and Equipment Support Rails are specified in Section 230500.

G. Vibration Control is specified in Section 230548.

H. Flexible Duct Connections are Specified in Section 233100.

I. Testing, Adjusting, and Balancing are specified in Section 230593.

J. Control and sequence of operation provisions are specified in respective Temperature Control Sections. Refer to Project Manual "Table of Contents" for respective automatic Temperature Control Section titles.

1.2 REFERENCES

A. Standards and documents referenced in text of this and complementary Sections shall be the edition current at date Project Manual was issued.

B. AFBMA (Anti-Friction Bearing Manufacturers Association)

1. AFBMA Std 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. AFBMA Std 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. AMCA (Air Movement and Control Association, Inc.)

1. AMCA 99 - Standards Handbook.
2. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
3. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
4. AMCA 301 - Method of Calculating Fan Sound Ratings from Lab Test Data.

D. NEMA (National Electrical Manufacturers Association)

1. NEMA MG-i - Motors and Generators.

1.3 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design Criteria: Drawings indicate sizes, profiles, connections, dimensional requirements, etc. of fans, exhausters, and ventilators, based on referenced products. Products having equivalent performance characteristics by other manufacturers may be considered, provided deviations in dimensions and profiles and efficiencies are suitable for the application and do not change the design concept or intended performance as judged by Architect/Engineer.

B. Furnished Fans: Capable of accommodating static pressure variations of plus or minus 10%; have performance that does not vary from specified criteria more than the following:

1. Not have decreased motor size, or increased noise level
2. Not have tip speed increased by more than 10%.
3. Not have inlet air velocity increased by more than 20%.

1.4 SUBMITTALS

A. Submit product data and shop drawings for each fan, exhauster, ventilator, fan curb, and accessory to be installed on this Project, in accordance with provisions of Section 230500. Submittals shall include, but not be limited to, the following:

1. Manufacturer’s drawings detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location of field connections.
2. Fan curves for proposed units, with system operating conditions clearly indicated.
3. Sound power ratings for both fan inlet and outlet at rated capacity.
4. Motor ratings and electrical characteristics, plus motor and fan accessories.
5. Damper data, including housings, linkages, and operators.
6. Manufacturer’s product certification, where applicable.

B. Operation and maintenance data shall comply with provisions of Section 230500 and also include instructions for lubrication, motor and drive replacement part numbers, availability, and service depot location and telephone number.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing and experienced in manufacture, assembly, and field performance of fans, exhausters, and ventilators; not less than three years in business.

B. Single Source Responsibility: In general, all fans, exhausters, and ventilators shall be the products of a single manufacturer. All units of each particular type shall be the products of a single manufacturer.

C. Fabrication: Conform to AMCA 99.

D. Performance Ratings: Based on tests made in conformance with AMCA 210.

E. Sound Ratings: Determined by AMCA 301, tested per AMCA 300.

F. NEMA Compliance: Provide electric motors and components that are NEMA listed and labeled.

G. Performance and Sound Rating Certification: Manufacturers shall certify that their products comply with specified requirements.

1.6 DELIVERY, STORANGE, AND HANDLING

A. Deliver products to site, properly store, and protect under applicable provisions of Section 230500.

B. Protect motors, shafts, and bearings from weather and construction dust.

C. If units must be stored outside for a prolonged period, remove motors and belts and store them inside a weathertight structure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Listed in respective fan, exhauster, and ventilator type complementary Sections.

B. Reference Product(s): Scheduled or noted on Drawings.

2.2 FANS, EXHAUSTERS, AND VENTILATORS, GENERAL

A. Type, Size, Performance, Characteristics, Arrangement, Accessories, Etc.: As scheduled or noted on Drawings for respective application; acceptable equivalent to products referenced on Drawings.

B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower.

C. Motors: Comply with applicable general provisions of Section 15170; designed for continuous operation in 40^0C environment, for temperature rise in accordance with NEMA MG-i limits for insulation class, service factor, and motor enclosure type; type specified, scheduled, or noted for respective units; open drip-proof type, except where specifically specified or noted otherwise for respective fans.

D. V-Belt Drives: 1.4 minimum service factor; fixed or adjustable type depending on motor horsepower and specifications for respective unit, generally as follows:

1. 15 HP and Under: Variable and adjustable pitch sheaves, selected so required rpm is obtained with sheaves set at mid-position.
2. 20 HP and Over: Fixed sheave, matched belts, rated as recommended by manufacturer or minimum 1.5 times nameplate rating of motor.
3. Sheaves: Cast iron or steel, dynamically balanced, keyed to shaft;
4. Belts: Oil-resistant, nonsparking, and nonstatic.
5. Belt Guard: Provide for all belt drives not enclosed in fan housing; fabricated from diamond mesh expanded metal or sheet stock; welded assembly with frame and mounting brackets, with provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place; secured to fan or fan support without short circuiting vibration isolation.

E. Lubrication Fittings: Extend to outside of casing.

F. Disconnect Switch: Nonfusible type, with thermal overload protection, unless indicated otherwise for a particular unit.

G. Special Features for Corrosive Environments: Provide for particular units when noted or scheduled on Drawings, corrosive protective coatings, Heresite or acceptable equivalent.

H. Special Features for Hazardous Environments: Provide for particular units when noted or scheduled on Drawings, spark-proof fan wheels and explosion-proof motors.

2.3 ROOF CURBS

A. Curbs: Prefabricated, specified in Section 230500.

B. Procure curbs with respective units when available from unit manufacturer.

C. Sound Attenuating Type: Curbs: Provide where indicated for respective units.

D. Verify curb manufacturer has coordinated curbs with respective units and roof construction prior to release for shipment.

2.4 BACKDRAFT DAMPERS

A. Multi-blade, gravity activated, balanced design; have blades linked together for parallel operation; equipped with aluminum blades pivoted on nylon bushings and resilient seals on blade closing edges; assembled in a heavy galvanized steel frame with provisions for conduit to pass through perimeter of damper without interfering with damper operation; factory set to close when fan stops.

B. Vertical Dampers: Equipped with adjustable counterweight or spring loaded for optimum operation.

2.5 FAN SPEED CONTROLS

A. Single Phase Speed Controls: Multiple speed selector switches or solid state variable speed controllers as indicated on Drawings; for wall mounting; furnished by respective fan manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, roof curbs, equipment supports, ductwork, and other conditions effecting performance of fans.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF FANS, EXHAUSTERS, AND VENTILATORS - COMMON REQUIREMENTS

A. Install units level and plumb. Align, lubricate, start, and balance units in accordance with manufacturer’s written instructions, with proper clearance and access for inspection and servicing.

B. Install roof mounted units on roof curbs or equipment support rails, as applicable. Secure units to curbs and rails with cadmium-plated hardware, properly isolated against vibration.

C. Install units with resilient mountings and flexible electrical leads.

D. Provide flexible duct connections between fans and connecting ductwork. Ensure metal components of flexible connections are parallel and have one inch minimum flex between ductwork and fan while running.

E. Install fan related items in a manner that will ensure vibration isolation provisions are not short circuited.

F. Install fan restraining snubbers where side torque or thrust may develop and where indicated on Drawings. Flexible connections shall not be in tension while fan is running.

G. Provide backdraft dampers for exhaust fans, arranged as indicated.

H. Provide safety screen where fan inlet or outlet is exposed.

I. Provide fixed sheaves where required for final air balance.

J. Provide speed controllers where indicated on Drawings for particular fans.

3.3 ADJUSTING AND CLEANING

A. Check damper operation and linkages. Adjust for proper damper operation.

B. Clean exterior and interior of each unit. Vacuum clean fan wheel and surfaces exposed to air handled by the unit.

3.4 FAN, EXHAUSTER, AND VENTILATOR COMMISSIONING

A. Perform following operations and checks before units are operated for any purpose:

1. Verify shipping blocking and bracing have been removed.
2. Verify unit is secure on mountings and supporting devices and connections for ductwork, electrical, etc. are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
3. Perform specified cleaning and adjusting.
4. Disconnect fan drives from motors, verify proper motor rotation, and verify fan wheel free rotation and smooth operation of bearings. Reconnect fan drive systems, align belts, and install belt guards.
5. Lubricate bearings and other moving parts with factory-recommended 1ubricants.
6. Verify manual and automatic volume control dampers are positioned properly and that fire and smoke dampers in related ductwork are in full-open position.
7. Disable automatic temperature control operators, where applicable.

B. Energize fan motors and adjust fans to indicated RPM. Replace fan and motor pulleys as required to achieve design conditions.

C. Shut units down and reconnect automatic temperature controls

D. Refer to Section 230593 for testing, adjusting, and balancing provisions.

3.5 DEMONSTRATION

A. Demonstrate equipment operation to Owner’s operating and maintenance personnel. Instruct personnel in procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventive maintenance, and how to obtain replacement parts.

B. Familiarize personnel with contents of Operating and Maintenance Manuals.

C. Schedule demonstration and instruction with at least 7 days advance notice.

END OF SECTION 233400

SECTION 233423 – HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Forward-curved centrifugal fans.
2. Ceiling- or wall-mounting ventilators.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

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.

C. Wiring Diagrams

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Product data
2. Product certificates
3. Wiring Diagrams
4. Warranty: Sample of warranty.
5. Field quality-control test reports.

1.4 QUALITY ASSUANCE

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. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

C. UL Standard: Power ventilators shall comply with UL 705.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AMCA Compliance: Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.

2.2 FORWARD-CURVED CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Greenheck.
2. Loren Cook Company.
3. Twin City Fan.

B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
3. Factory-installed and -wired disconnect switch.

C. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff.
2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
3. Spun inlet cone with flange.
4. Outlet flange.

D. Forward-Curved Wheels:

1. Black-enameled or galvanized-steel construction with inlet flange, backplate, shallow blades with inlet and tip curved forward in direction of airflow.
2. Mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.

E. Shafts:

1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

F. Grease-Lubricated Shaft Bearings:
   1. Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.

G. Belt Drives:

   1. Factory mounted, with adjustable alignment and belt tensioning.
   2. Service Factor Based on Fan Motor Size: 1.5.
   3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
   4. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
   5. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
   6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
   7. Motor Mount: Adjustable for belt tensioning.

H. Accessories:

   1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
   2. Scroll Drain Connection: NPS 1 (DN 25) steel pipe coupling welded to low point of fan scroll.
   3. Companion Flanges: Rolled flanges for duct connections of same material as housing.

2.3 CEILING- OR WALL-MOUNTING VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

   1. Panasonic.

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 galvanized, 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. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
3. Companion Flanges: For inlet and outlet duct connections.
4. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
6. Wall caps, where required, shall be galvanized metal.
7. Radiation damper as required for UL rated floor/ceiling assemblies.

2.4 MOTORS

A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Install units with clearances for service and maintenance.

C. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

D. 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."

E. Install ducts adjacent to power ventilators to allow service and maintenance.

F. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 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. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 233423

SECTION 233713 – DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Louver face diffusers.
3. Adjustable bar registers and grilles.
4. Fixed face registers and grilles.

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.

1.2 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. Color chart.

B. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Product data.
2. Product certificates.
3. Source quality-control reports.
4. Field quality-control reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

1. Anemostat.
2. Krueger.
3. Metalaire.
4. Price.
5. Titus.
6. Tuttle & Bailey.
7. Nailor.

B. Provide thermally adjustable diffusers manufactured by Acutherm.

2.2 CEILING DIFFUSERS

A. Square Ceiling Diffusers:

1. As specified on drawing schedule.

2.3 DUCT DIFFUSERS

A. Duct Diffusers:

1. As specified on drawing schedule.

2.4 REGISTERS AND GRILLES

A. Return/Transfer Grille:

1. Grilles shall be of aluminum construction, consisting of aluminum 1/2" x 1/2" x 1/2" grid and an extruded aluminum border.
2. The grille shall be finished in B12 White Powder Coat.

2.5 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 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.

3.2 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 238219 – AIR HANDLING UNITS AND CONDENSING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes fan-coil units and accessories.

1.2 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

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.

1.3 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.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Product data.
2. Product certificates.
3. Wiring Diagrams.
4. Field quality-control reports.
5. Warranty: Sample of special warranty.

PART 2 - PRODUCTS

2.1 DUCTED FAN-COIL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

1. Lennox.

B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

C. Coil Section Insulation: 1/2-inch thick foil-faced glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.

D. Drain Pans: Insulated galvanized steel with plastic liner. Fabricate pans and drain connections to comply with ASHRAE 62.1.

E. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panels.

F. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.

G. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Glass Fiber Treated with Adhesive: 80 percent arrestance and MERV 6.

H. Direct Drive Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the cabinet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

1. Motors: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

I. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.

J. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

K. Control devices and operational sequence are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls."

L. Electrical Connection: Factory wire motors and controls for a single electrical connection.

2.2 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in factory standard color, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

    a. Compressor Type: Scroll.
    b. Two-speed or invertor driven compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
    c. Refrigerant: R-410A.
    d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.

3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Mounting Base: Polyethylene.

2.3 ACCESSORIES

A. Thermostat: Low-voltage.

B. Remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection including auto setting.

C. Automatic-reset timer to prevent rapid cycling of compressor.

D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

E. Drain Hose: For condensate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fan-coil units to comply with NFPA 90A.

B. Suspend fan-coil units from structure with elastomeric hangers. Vibration isolators are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install new filters in each fan-coil unit within two weeks after Substantial Completion.

D. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.
2. Connect piping to fan-coil-unit factory hydronic piping package. Install piping package if shipped loose.
3. Connect condensate drain to indirect waste.

   a. Install condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.

E. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Section 233300 "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

F. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 238219

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For sleeve seals.
2. Shop Drawings: For seismic restraints, signed and sealed by a qualified professional engineer.

    a. Design analysis to support selection and arrangement of seismic restraints.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: B.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.

    a. Component Importance Factor: 1.25.
    b. Component Response Modification Factor: 5.0.
    c. Component Amplification Factor: 2.5.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 30%.
4. Design Spectral Response Acceleration at 1.0 Second Period: 10%.

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 NFPA 70.

2.2 RACEWAYS

A. Raceways:

1. EMT: ANSI C80.3 and UL 797.
2. ENT: NEMA TC 13 and UL 1653.
3. FMC: UL 1; zinc-coated steel.
4. IMC: ANSI C80.6, zinc-coated steel, with threaded fittings.
5. GRC: ANSI C80.1 and UL 6, hot-dip galvanized.

6. LFMC: UL 360, zinc-coated, flexible steel with sunlight-resistant and mineral-oil-resistant plastic jacket.
7. RNC: UL 621 and NEMA TC 2, Type EPC-40-PVC, with NEMA TC3 fittings.
8. Raceway Fittings: Specifically designed for raceway type used in Project.

B. Wireways: Sheet metal sized and shaped, with screw covers.

C. Surface Raceways:

1. Metal: Galvanized steel with snap-on covers. Prime coating, ready for field painting.
2. Plastic: PVC, extruded and fabricated to size and shape indicated in color selected, with snap-on cover and mechanically coupled connections with plastic fasteners.

D. Floor Boxes: Cast metal, fully adjustable, rectangular.

E. Handholes and Boxes for Exterior Underground Wiring:

1. 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.
2. Comply with SCTE 77.
3. Configuration: Designed for flush burial with open 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."

2.3 CONDUCTORS AND CABLES

A. Conductors:

1. Comply with NEMA WC70.
2. Conductors, No. 10 AWG and Smaller: Solid or stranded copper.
3. Conductors, Larger Than No. 10 AWG: Stranded copper.
4. Insulation: Thermoplastic, Type THHN-THWN or XHHW.
5. Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.

2.4 GROUNDING MATERIALS

A. Conductors: Solid for No. 8 AWG and smaller, and stranded for No. 6 AWG and larger unless otherwise indicated.

1. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
2. Bare, Solid-Copper Conductors: Comply with ASTM B 3.

3. Bare, Stranded-Copper Conductors: Comply with ASTM B 8.

B. Ground Rods: Copper-clad steel, sectional type; 5/8 by 96 inches in diameter.

C. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts with clamp-type pipe connectors sized for pipe.

D. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.5 ELECTRICAL IDENTIFICATION MATERIALS

A. Raceway Identification Materials: Self-adhesive, color-coding vinyl tape; flexible, preprinted, self-adhesive vinyl.

B. Conductor Identification Materials: Color-Coding Conductor Tape: Self-adhesive vinyl tape 1 to 2 inches wide.

C. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, polyethylene tape with continuous metallic strip or core.

D. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with circuit identification legend machine printed by thermal transfer or equivalent process.

E. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

F. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.

G. Equipment Identification Labels: Engraved, laminated acrylic or melamine label; punched or drilled for screw mounting. White letters on a dark-gray background; red letters for emergency systems.

H. Fasteners: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.6 SUPPORT AND ANCHORAGE COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly, and provide finish suitable for the environment in which installed.

1. Channel Dimensions: Selected for structural loading and applicable seismic forces.

B. Raceway and Cable Supports: As described in NECA 1.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and fittings.

D. Mounting, Anchoring, and Attachment Components:

1. Powder-Actuated Fasteners: Threaded-steel stud.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete.
3. Concrete Inserts: Steel or malleable-iron, slotted-support-system units similar to MSS Type 18; complying with MFMA-3 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, high strength; complying with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.7 SEISMIC-RESTRAINT COMPONENTS

A. Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Strength in tension, shear, and pullout force of components used shall be at least four times the maximum seismic forces to which they will be subjected.

B. Angle and Channel-Type Brace Assemblies: Steel angles or steel slotted-support-system components; with accessories for attachment to braced component at one end and to building structure at the other end.

C. Cable Restraints: ASTM A 603, zinc-coated, steel wire rope attached to steel or stainless-steel thimbles, brackets, swivels, and bolts designed for restraining cable service.

1. Seismic Mountings, Anchors, and Attachments: Devices as specified in "Support and Anchorage Components" Article, selected to resist seismic forces.
2. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.
3. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to type and size of anchor bolts and studs used.
4. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to type and size of attachment devices used.

2.8 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized-steel sheet.

D. Sleeve Seals: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Stainless steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.9 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining.

PART 3 - EXECUTION

3.1 GENERAL ELECTRICAL EQUIPMENT INSTALLATION REQUIREMENTS

A. Install electrical equipment to allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

B. Install electrical equipment to provide for ease of disconnecting the equipment with minimum interference to other installations.

C. Install electrical equipment to allow right of way for piping and conduit installed at required slope.

D. Install electrical equipment to ensure that connecting raceways, cables, wireways, cable trays, and busways are clear of obstructions and of the working and access space of other equipment.

E. Install required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

F. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Comply with requirements in Section 083113 "Access Doors and Frames."

G. Install sleeve and sleeve seals of type and number required for sealing electrical service penetrations of exterior walls.

H. Comply with NECA 1.

3.2 RACEWAY AND CABLE INSTALLATION

A. Outdoor Raceways Applications:

1. Exposed or Concealed: IMC.
2. Underground, Single Run: RNC.
3. Connection to Vibrating Equipment: LFMC.
4. Boxes and Enclosures: Metallic, NEMA 250, Type 3R or Type 4.

B. Indoor Raceways Applications:

1. Exposed or Concealed: EMT.
2. Connection to Vibrating Equipment: FMC; in wet or damp locations, use LFMC.
3. Damp or Wet Locations: IMC.
4. Boxes and Enclosures: Metallic, NEMA 250, Type 1, unless otherwise indicated.

C. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.

D. Install raceways and cables at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.

E. Install raceways embedded in slabs in middle third of slab thickness where practical, and leave at least 1-inch-thick concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.
3. Install conduit larger than 1-inch trade size, parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.
4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.

F. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

G. Install pull wires in empty raceways.

H. Connect motors and equipment subject to vibration, noise transmission, or movement with a 72-inch maximum length of flexible conduit.

I. Install raceways and cables conceal within finished walls, ceilings, and floors unless otherwise indicated.

J. Install raceways and cables at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.

K. Installation of Hangers and Supports:

1. Comply with NECA 1 and NECA 101 for installation requirements, except as specified in this article.
2. Separate dissimilar metals and metal products from contact with wood or cementitious materials, by painting each metal surface in area of contact with a bituminous coating or by other permanent separation.
3. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
4. Multiple Raceways or Cables: Install on trapeze-type supports fabricated with steel slotted channel.
5. 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. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
6. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods, unless otherwise indicated or required by Code:

   a. To Wood: Fasten with lag screws or through bolts.
   b. To New Concrete: Bolt to concrete inserts.
   c. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   d. To Existing Concrete: Expansion anchor fasteners.
   e. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
   f. To Light Steel: Sheet metal screws.
   g. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount on slotted-channel racks attached to substrate.

7. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway

B. Exposed Feeders, Branch Circuits, and Class 1 Control Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

C. Feeders and Branch Circuits Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Feeders and Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and underground: Type THHN-THWN, single conductors in raceway.

E. 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.

F. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.4 GROUNDING

A. Underground Grounding Conductors: Install bare copper conductor, No. 3/0 AWG minimum. Bury at least 24 inches below grade.

B. Pipe and Equipment Grounding Conductor Terminations: Bolted.

C. Underground Connections: Welded.

D. Connections to Structural Steel: Bolted.

E. Install grounding conductors routed 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.

F. Install ground rods driven into ground until tops are 2 inches below final grade, or 4 inches above, finished floor slab unless otherwise indicated.

G. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape.

H. Make connections without exposing steel or damaging coating if any.

I. Install bonding straps and jumpers in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

J. Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

K. Bond to equipment mounted on vibration isolation hangers and supports so vibration is not transmitted to rigidly mounted equipment.

L. 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, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, 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.

M. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.

1. Measure ground resistance not less 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.
2. Perform tests by fall-of-potential method according to IEEE 81.
3. Report measured ground resistances that exceeds 10 ohms.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.5 IDENTIFICATION

A. Power-Circuit Conductor Identification: For No. 3 AWG conductors and larger, at each location where observable, identify phase using color-coding conductor tape.

B. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring.

C. Warning Labels for Enclosures for Power and Lighting: Comply with 29 CFR 1910.145; identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

D. Equipment Identification Labels:

1. Labeling Instructions:

a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high.
b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment.
c. Elevated Components: Increase sizes of labels and legend to those appropriate for viewing from the floor.

2. Equipment to Be Labeled:

a. Panelboards, electrical cabinets, and enclosures.
b. Electrical switchgear and switchboards.
c. Transformers.
d. Motor-control centers.
e. Disconnect switches.

f. Enclosed circuit breakers.
g. Motor starters.
h. Push-button stations.
i. Power transfer equipment.
j. Contactors.

E. Verify identity of each item before installing identification products.

F. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

G. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

H. Install system identification color banding for raceways and cables at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

I. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Ungrounded service, feeder and branch-circuit conductors.

1. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

2. Colors for 480/277-V Circuits:

a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.

3. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points.

J. Underground-Line Warning Tape: Continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade.

3.6 SEISMIC REQUIREMENTS

A. Install seismic-restraint components using methods approved by the evaluation service providing required submittals for component.

B. Install bushing assemblies for anchor bolts for wall- and floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in substrate.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

D. Accommodation of Differential Seismic Motion: Make flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross expansion and seismic-control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to electrical equipment that is anchored to a different structural element than the one supporting them as they approach equipment.

3.7 SLEEVE AND SLEEVE-SEALS INSTALLATION

A. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

B. Cut sleeves to length for mounting flush with both wall surfaces.

C. Extend sleeves installed in floors 2 inches above finished floor level.

D. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

E. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

F. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Section 079200 "Joint Sealants."

G. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

H. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

I. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.8 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Comply with requirements in Section 078413 "Penetration Firestopping."

END OF SECTION 260500

SECTION 260513 – ELECTRICAL SERVICE

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor must complete this work in accordance with Duke Energy Electric Service Guidelines for Commercial/Industrial Developments.

B. If any part of this specification section conflicts with Duke Energy's requirements, Duke Energy's requirements shall apply

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conduit

1. All conduits furnished and installed by the Contractor shall meet the following criteria:

   a. Shall be made from polyethlylene (PE) or polyvinyl chloride (PVC)

   b. Appropriate National Electrical Manufacturers Association (NEMA) standards for electric utility installations.

   c. Suitable for use with underground electric distribution cables rated at 90°C

   d. Shall have UL listing

   e. Shall have a schedule 40 rating clearly printed on the exterior surface.

B. Conduit Bends

   a. All conduit bends shall be made of PVC. All bends shall be 90° or less "Sweep" bends with a minimum radius of 36 inches. Field made bends are not acceptable.

C. Primary Conduit

1. The Contractor shall provide and install all required conduits for underground primary cable. The minimum inside diameter of the conduit shall be four (4) inches. Larger conduit may be required for some installations. Duke Energy will determine the conduit size and locations.

2. Conduit shall be installed at least 30 inches deep (no more than 36 inches deep at the end points). The conduit route shall have a maximum of four (4) conduit bends

and shall be approved by Duke Energy prior to installation. If the proposed conduit route exceeds 600 feet, the Contractor shall provide an alternate cable route or provide and install an approved splice box or manhole.

3. The Contractor is required to install a continuous pull cord in each conduit run and securely cap both ends of the conduits with duct plugs or caps. Duct caps or plugs are NOT to be glued in place.

4. The Contractor must also mark the location of the ends of the conduit by placing a stake above ground over the end of the conduit. The strake will be labeled “End of Duct”. The integrity of the conduit system is the Contractor’s responsibility. The Contractor should contact other utilities to determine their specific conduit requirements.

D. Service Conduit

1. The Contractor shall furnish and install conduit from its building to the service pole, secondary pedestal, or pad mount transformer from which service will be provided.

E. Transformer Pad

1. The Contractor shall provide a transformer pad in accordance with Duke energy standards for all installations requiring a three-phase pad-mount transformer. The following items are to be approved by Duke Energy before installation:

a. The transformer installation must be located where it is accessible by standard Duke Energy construction and maintenance equipment. There must be a permanent vehicle access within 10 feet of the three-phase transformer pads and within 25 feet of single-phase transformer pads. Access routes across non-paved areas require an eight-inch thick gravel base.

b. Transformers or other service equipment must be located away from buildings and from building openings as required by local codes and the National Electric Code (NEC). A 10-foot clear zone must also be maintained in front of access doors to Duke Energy equipment to allow for operation and maintenance activities. Shrubbery or storage of equipment or material is prohibited in the clear zone.

c. The Contractor shall install the transformer pad on a layer of firmly compacted granular backfill. Primary and service conduits and bends entering the transformer pad must be installed at the same time as the transformer pad at least to the point where they extend beyond the edges of the transformer pad. The pad is to be level and flat in all directions.

d. The Contractor shall protect padmount transformer installations from damage by vehicles.

F. Other Underground Facilities

1. The Contractor shall extend water and sewer connections beyond the electrical utility trench where possible. This reduces the change of the Contractor incurring additional charges associated with damage to Duke Energy facilities when installing other utility services.

G. Meter Base Location

1. Duke Energy reserves the right to approve the location of all electric service delivery points and the location of electric meter bases. This location will generally be at the padmount transformer.

H. Telephone Line Requirements

1. The Contractor is required to provide a telephone line at the utility meter point for all services with a demand of 500 kW or greater. The purpose of the telephone line is to provide the capability to remotely interrogate the meter for billing purposes. A dedicated line is required. The Owner is responsible for monthly charges. In cases where access to a telephone line is not available, please contact Duke Energy.

2. If a smaller service is installed and future load growth is anticipated that will increase the service to more than 500 kW, it is strongly recommended that the telephone service be installed during the construction of the initial electric service.

PART 3 - EXECUTION

3.1 TEMPORARY ELECTRIC SERVICE

A. Standard Overhead Temporary Service. When temporary overhead service is requested and an overhead secondary voltage is located within 100 feet of the Contractor's meter structure, the customer shall pay a non-refundable payment of $200 to Duke Energy within 30 days of invoice. The installation must allow for proper clearances in accordance with the National Electric Safety Code (NESC).

B. Standard Underground Temporary Service. When temporary underground service is requested and an existing padmount transformer or secondary junction cabinet is located within five feet of the Contractor's meter structure, the customer shall pay a non-refundable payment of $120 to Duke Energy with 30 days of invoice. The Contractor shall coil at least 10 feet of conductor for Duke Energy to make the final connections.

C. Non-Standard Temporary Service. When a temporary service is required which requires facilities in addition to those listed above, the Contractor shall also pay a non-refundable payment to Duke Energy for those additional facilities prior to construction in an amount equal to their estimated construction and retirement costs.

1. Cover adjacent surfaces with materials that are proven to resist chemical cleaners used unless chemical cleaners being used will not damage adjacent surfaces. Use materials that contain only waterproof, UV-resistant adhesives. Apply masking

agents to comply with manufacturer's written instructions. When no longer needed, promptly remove masking to prevent adhesive staining.

2. Keep wall wet below area being cleaned to prevent streaking from runoff.

3.2 SERVICE REQUIREMENTS FOR UNDERGROUND PRIMARY ELECTRIC SERVICE FROM AN OVERHEAD DISTRIBUTION LINE

A. System Route and Equipment Location:

1. Duke Energy shall be responsible for determining the final routing for underground primary cables. The cable route must be accessible for maintenance along its entire length. The Contractor shall provide a level location at final grade for a padmount transformer installation as directed by the Utility.

a. The Contractor shall be responsible for constructing a transformer pad for three-phase installations in accordance with Duke Energy requirements. The three-phase transformer pad must be located within 10 feet of a permanent driveway or other area accessible to Duke Energy construction and maintenance equipment. No part of the transformer (or transformer pad) may be within 10 feet from any combustible wall, window, or ventilation opening and 20 feet from any doorway in a building. There must be at least three (3) feet of clearance between customer equipment or landscaping and the side of the transformer (or transformer pad) and 10 feet of clearance to the front of the transformer (or transformer pad). Local regulations may require additional clearances to padmount equipment.

B. Trench Dimensions and Clearances

1. The primary conduit system shall be a minimum of 30 inches (maximum of 36 inches deep at the conduit end points). it must be at least three (3) feet away from adjacent gas pipes or water lines. It shall be at least one (1) foot away from all other underground utilities. The surface grade over the conduit system shall not be changed in any way that reduces or increases the depth of burial.

C. Materials and Labor

1. The Contractor shall provide all materials and excavation labor necessary to install the underground conduit system. This includes trenching, backfilling, installation of conduit and conduit accessories, installation of precast manholes and cable pits, installation of transformer foundation, etc.

D. Conduit

1. The Contractor shall install the conduit system including duct, manholes, cable pits and transformer foundations, etc., and the Owner shall own and maintain the system.

2. Conduit shall be installed in accordance with Duke Energy standards.

3. The conduit shall be made from either polyethylene (PE) or polyvinyl chloride (PVC) and suitable for use with underground electric distribution cable rated at 90°C.

4. All conduits shall have a UL listing and a schedule 40 rating clearly printed on the exterior surface. For primary jacketed concentric neutral primary cables, the minimum inside diameter of the conduit shall be four (4) inches. For all other primary cables, a minimum inside diameter of six (6) inches is required.

5. All bends shall be 90° or less “Sweep” bends with a minimum radius of 36 inches.

6. Conduit may be direct buried if local permitting authorities will allow direct buried conduit systems. All conduits shall have a pull string installed. All conduits shall be capped to prevent debris from entering the conduit.

3.3 INSTALLATION REQUIREMENTS FOR THREE-PHASE PADMOUNT TRANSFORMER FOUNDATIONS

A. Location:

1. Duke Energy shall be responsible for determining the final location for the transformer pad. The Contractor shall provide a level location for a padmount transformer installation as directed by the Utility. The three-phase transformer must be located adjacent to and within 10 feet of a driveway

2. The Contractor shall be responsible for constructing a transformer pad for three-phase installations in accordance with Duke Energy requirements. The three-phase transformer pad must be located within 10 feet of a permanent driveway or other area accessible to Duke Energy construction and maintenance equipment. No part of the transformer (or transformer pad) may be within 10 feet from any combustible wall, window, or ventilation opening and 20 feet from any doorway in a building. There must be at least three (3) feet of clearance between customer equipment or landscaping and the side of the transformer (or transformer pad) and 10 feet of clearance to the front of the transformer (or transformer pad) .

B. Design:

1. The Contractor is responsible for constructing a transformer pad in accordance with Duke Energy requirements suitable for the largest transformer that may be required. The Contractor shall consider frost action, drainage and local soil conditions when developing the structural design of the transformer pad. Specific requirements include:

   a. The transformer pad shall be a minimum of eight (8) inches thick. The top surface shall be a minimum of two (2) inches above the surrounding grade. Reinforcing steel shall be at least #4 bars or larger. It shall be installed a minimum of 12 inches O.C. both ways.

   b. The transformer pad shall be installed on a bed of granular fill materials that has been compacted prior to pouring concrete.

c. The surface of the transformer pad shall be flat, smooth and level with 1.0 inch in all directions.

d. The edge of the transformer pad shall have a one (1) inch bevel formed into the top edge.

e. A one-inch ID PVC conduit shall be installed in the concrete as shown in the sketch for the installation of ground conductors shown on the plans for adjacent communications equipment (required by NESC).

C. Materials and Labor

1. The Contractor shall provide all materials and excavation labor necessary to install the transformer pad. This includes excavation, backfilling, installation of conduit and conduit accessories, building forms, poring and finishing concrete, etc.

D. Conduit

1. The Contractor shall install the conduits entering the transformer pad and the Owner shall own and maintain said conduits. It shall be installed in accord with Duke Energy standards.

2. The conduit shall be made from either polyethylene (PE) or polyvinyl chloride (PVC) and suitable for use with underground electric distribution cable rated at 90°C.

3. All conduits shall have a UL listing and a schedule 40 rating clearly printed on the exterior surface. For primary jacketed concentric neutral primary cables, the minimum inside diameter of the conduit shall be four (4) inches. Duke Energy may require larger sizes. All conduits must have a pull string installed and be capped to prevent debris from getting into the conduit.

END OF SECTION 260513

SECTION 260519 – LOW-VOLTAGE ELCTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Single conductor building wire.

B. Nonmetallic-sheathed cable.

C. Service entrance cable.

D. Metal-clad cable.

E. Wiring connectors and connections for 600 volts or less.

F. Electrical tape.

G. Heat shrink tubing.

H. Oxide inhibiting compound.

I. Wire pulling lubricant.

1.2 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

C. Section 28 31 00 - Fire Detection and Alarm: Fire alarm system conductors and cables.

1.3 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2001 (Reapproved 2007).

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010.

D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2009).

E. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers; 2005.

F. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy Wire for Subsequent Covering of Insulation; 2007.

G. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.

H. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2008.

I. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

J. NECA 104 - Recommended Practice for Installing Aluminum Building Wire and Cable; National Electrical Contractors Association; 2006 (NECA/AA 104).

K. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); National Electrical Contractors Association; 2006.

L. NECA 121 - Standard for Installing Nonmetallic-Sheathed Cable (Type NM-B) and Underground Feeder and Branch-Circuit Cable (Type UF); National Electrical Contractors Association; 2007.

M. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; National Electrical Manufacturers Association; 2009 (ANSI/NEMA WC 70/ICEA S-95-658).

N. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2009.

O. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

P. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.

Q. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.

R. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.

S. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.

T. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.

U. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

V. UL 719 - Nonmetallic-Sheathed Cables; Current Edition, Including All Revisions.

W. UL 854 - Service-Entrance Cables; Current Edition, Including All Revisions.

X. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
3. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Administrative Requirements for general submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the Authorities Having Jurisdiction, and marked for its intended use.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.8 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions.

When installation below this temperature is unavoidable, notify Engineer and obtain direction before proceeding with work.

B. Comply with NEMA WC 70 for copper and aluminum conductors including their insulation materials.

C. Comply with NEMA WC 5.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Nonmetallic-sheathed cable is not permitted.

D. Underground feeder and branch-circuit cable is not permitted.

E. Metal-clad cable is permitted only as follows:

1. Where not otherwise restricted, may be used:

   a. Where concealed in hollow stud walls, above accessible ceilings.

2. In addition to other applicable restrictions, may not be used:

   a. Where exposed to view.
   b. Where exposed to damage.
   c. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.

2.2 CONDUCTOR AND CABLE MANUFACTURERS

A. Cerro Wire LLC: www.cerrowire.com.

B. Industrial Wire & Cable, Inc: www.iewc.com.

C. Southwire Company: www.southwire.com.

D. Alcan; Model Stabiloy: www.cable.alcan.com

E. Belden: www.belden.com.

F. General Cable: www.generalcable.com

G. USA Cable: www.USAwire-cable.com

H. AmerCable: www.amercable.com

I. Substitutions: See Section 01 60 00 - Product Requirements.

2.3 ALL CONDUCTORS AND CABLES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductor Material:

1. Provide copper conductors except where aluminum conductors are specifically indicated or permitted for substitution. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.

   a. Substitution of aluminum conductors for copper is permitted, when approved by Owner and authority having jurisdiction, only for the following:

      1) Services: Copper conductors size 3 AWG or larger.
      2) Feeders: Copper conductors size 3 AWG or larger.

   b. Where aluminum conductors are substituted for copper, comply with the following:

      1) Size aluminum conductors to provide, when compared to copper sizes indicated, equivalent or greater ampacity and equivalent or less voltage drop.
      2) Increase size of raceways, boxes, wiring gutters, enclosures, etc. as required to accommodate aluminum conductors.
      3) Provide aluminum equipment grounding conductor sized according to NFPA 70.

2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.
3. Tinned Copper Conductors: Comply with ASTM B33.
4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM

B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.

H. Minimum Conductor Size:

1. Branch Circuits: 12 AWG.

a. Exceptions:

1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.

I. Conductor Color Coding:

1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.

a. Conductors size 6 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.

3. Color Code:

a. 208Y/120 V, 3 Phase, 4 Wire System:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.
4) Neutral/Grounded: White.

b. Equipment Ground, All Systems: Green.

2.4 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:

1. Copper Building Wire:

a. Cerro Wire LLC: www.cerrowire.com.
b. Encore Wire Corporation: www.encorewire.com.
c. Southwire Company: www.southwire.com.
d. Substitutions: See Section 01 60 00 - Product Requirements.

2. Aluminum Building Wire (only where specifically indicated or permitted for substitution):

a. Alcan Products Corporation/Alcan Cable: www.cable.alcan.com.
b. Prysmian Power Cables and Systems: www.us.prysmian.com.
c. Southwire Company: www.southwire.com.
d. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:

1. Feeders and Branch Circuits:

a. Size 10 AWG and Smaller: Solid.

b. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:

1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
2. Aluminum Building Wire (only where specifically indicated or permitted for substitution): Type XHHW-2.

2.5 METAL-CLAD CABLE

A. Manufacturers:

1. AFC Cable Systems Inc: www.afcweb.com.
2. Encore Wire Corporation: www.encorewire.com.
3. Southwire Company: www.southwire.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:

1. Size 10 AWG and Smaller: Solid.
2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

F. Grounding: Full-size integral equipment grounding conductor.

G. Armor: Steel, interlocked tape.

H. Provide PVC jacket applied over cable armor where indicated or required for environment of installed location.

2.6 WIRING CONNECTORS AND TERMINATIONS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Wiring Connectors for Splices and Taps:

1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

3. Connectors for Aluminum Conductors: Use compression connectors.

C. Wiring Connectors for Terminations:

1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.

D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

E. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

F. Mechanical Connectors: Provide bolted type or set-screw type.

G. Compression Connectors: Provide circumferential type or hex type crimp configuration.

H. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

2.7 WIRING ACCESSORIES

A. Electrical Tape:

1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
3. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
4. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
5. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.

6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.

D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as shown on the drawings.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

A. Circuiting Requirements:

1. Unless dimensioned, circuit routing indicated is diagrammatic.
2. When circuit destination is indicated and routing is not shown, determine exact routing required.
3. Arrange circuiting to minimize splices.
4. Include circuit lengths required to install connected devices within 10 ft of location shown.
5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.

7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are shown as separate, combining them together in a single raceway is permitted, under the following conditions:
   a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
   b. Increase size of conductors as required to account for ampacity derating.
   c. Size raceways, boxes, etc. to accommodate conductors.
8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is permitted where not otherwise prohibited, except for the following:
   a. Branch circuits fed from ground fault circuit interrupter (GFCI) circuit breakers.
   b. Branch circuits fed from feed-through protection of GFI receptacles.
   c. Branch circuits with dimming controls.
   d. Branch circuits with isolated grounding conductor.

B. Install products in accordance with manufacturer's instructions.

C. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.

D. Install aluminum conductors in accordance with NECA 104.

E. Install metal-clad cable (Type MC) in accordance with NECA 120.

F. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

H. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
   1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
   2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

I. Terminate cables using suitable fittings.

1. Metal-Clad Cable (Type MC):
   a. Use listed fittings.
   b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

J. Install conductors with a minimum of 12 inches of slack at each outlet.

K. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.

L. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

M. Make wiring connections using specified wiring connectors.
   1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
   2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
   3. Do not remove conductor strands to facilitate insertion into connector.
   4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
   5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
   6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

N. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
   1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
      a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
      b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
   2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
      a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
      b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
   3. Wet Locations: Use heat shrink tubing.

O. Insulate ends of spare conductors using vinyl insulating electrical tape.

P. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

Q. Identify conductors and cables in accordance with Section 26 05 53.

R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

S. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

T. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface. Support and train all feeders within switchboards away from open bus bars and sharp metal edges within cabinets.

U. Neatly train and lace wiring inside boxes, equipment, and panelboards.

3.4 FIELD QUALITY CONTROL

A. Perform inspection, testing, and adjusting in accordance with Section 01 40 00.

B. Inspect and test in accordance with NETA STD ATS, except Section 4.

C. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.

D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 260519

SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Provide all components necessary to complete the grounding system(s) consisting of:

1. Existing metal underground water pipe.
2. Metal underground water pipe.
3. Metal frame of the building.
4. Concrete-encased electrode.
5. Metal underground gas piping system.
6. Rod electrodes.

1.2 RELATED REQUIREMENTS

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.

B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

B. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2009.

C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.4 PERFORMANCE REQUIREMENTS

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Product Data: Provide for grounding electrodes, connections and specific purpose conductors.

C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

D. Project Record Documents: Record actual locations of components and grounding electrodes.

E. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.2 GROUNDING AND BONDING COMPONENTS

A. General Requirements:

1. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in addition to requirements of Section 26 05 19:

1. Use insulated copper conductors unless otherwise indicated.

a. Exceptions:

1) Use bare copper conductors where installed underground in direct contact with earth.
2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

D. Cooper Power Systems, a division of Cooper Industries: www.cooperindustries.com.

E. Framatome Connectors International: www.fciconnect.com.

F. Lightning Master Corporation: www.lightningmaster.com.

G. Substitutions: See Section 01 60 00 - Product Requirements.

2.3 CONNECTORS AND ACCESSORIES

A. Mechanical (Bolted) Connectors.

1. Bolted connectors for conductors and pipes: bronze, copper, and copper alloy, bolted compression type specifically manufactured for application needed.
2. Pipe connectors, clamp type, sized for pipe to be grounded.
3. Product: CADWELD manufactured by Erico.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Exothermic Connections:

1. Uses required: all concealed underground and structural steel.
2. Product: CADWELD manufactured by Erico.
3. Product: ULTRAWELD manufactured by Harger.
4. Product: EXOWELD manufactured by LP1.
5. Substitutions: See Section 01 60 00 - Product Requirements.

C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as shown on the drawings.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify existing conditions prior to beginning work.

E. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.

C. Make grounding and bonding connections using specified connectors.

1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

D. Identify grounding and bonding system components in accordance with Section 26 05 53.

E. Install ground electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.

1. Drive electrodes down until tops are at least 2" below finished grade, unless indicated otherwise.
2. Interconnect grounding electrodes with buried bare copper, 3/0 minimum size. Bury conductor at least 24" below finished grade.
3. Grounding electrode system shall consist of at least 3 electrodes spaced at least 10' apart preferably in a triangle arrangement.

F. Provide grounding well with cover at rod locations where indicated. Install with top flush to finished grade.

G. Install bare copper wire in foundation footing where indicated.

H. Provide bonding to meet requirements described in Quality Assurance. Bond in area readily accessible for inspection and maintenance, except for short runs in 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 so vibration is not transmitted to/from rigidly mounted equipment.
3. Exothermic Welded Connections: required for all buried connections except where specifically noted to do otherwise.
4. 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, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts on the flange. Where a dielectric main water fitting is installed, conduit or sleeve to conductor at each end.
5. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with bolted connector.
6. Above Ground Portion of Gas Piping System downstream from equipment shutoff valve.

I. Equipment/Device Specific Grounding & Bonding Requirements: Provide separate, insulated conductor within each feeder and branch circuit raceway according NFPA 70. Terminate each end on suitable lug, bus, or bushing.

1. In addition to NFPA 70 requirements, provide insulated grounding conductors for:
   a. Feeders and branch circuits.
   b. Lighting circuits.
   c. Receptacle circuits.
   d. Single phase motor and appliance circuits.
   e. 3-phase motor and appliance circuits.
   f. Flexible raceway runs.
   g. Armored and metal-clad cable runs.
2. 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.
3. Water Heater, Heat Tracing, and Anti frost 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.
4. 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.

5. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4" x 2" x 12" grounding bus.
6. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
7. Metal 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.

3.3 FIELD QUALITY CONTROL

A. Owner will provide field inspection in accordance with Section 01 40 00.

B. Perform inspection, testing, and adjusting in accordance with Section 01 40 00.

C. Inspect and test in accordance with NETA STD ATS except Section 4.

D. Perform inspections and tests listed in NETA STD ATS, Section 7.13.

E. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

F. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION 260526

SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Conduit and equipment supports.

B. Anchors and fasteners.

C. Equipment concrete pad requirements.

1.2 RELATED REQUIREMENTS

A. General Conditions, Supplementary Conditions and Division 01 apply to this section.

1.3 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2009.

B. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2009.

C. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2006

D. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2010

E. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2009.

F. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

G. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's catalog data for fastening systems.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

C. Welding: Qualify procedures and personnel according to AW D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - GENERAL

2.1 MATERIALS -- SUPPORT AND ATTACHMENT COMPONENTS

A. Hangers and Supports - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.

B. Supports: Fabricated of structural steel or formed steel members; hot-dipped galvanized after fabrication and applied according to MFMA-4.

1. 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. Allied Tube and Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation
d. GS Metals Corporation.
e. Thomas and Betts Corporation
f. Unistrut; Tyco International, Ltd.

2. Channel/strut dimensions: as selected for applicable load criteria.
3. Raceway and cable supports as described in NECA 1 and NECA 101.
4. Conduit and cable support devices -- hangers, clamps and associated fittings, designed for types and sizes of raceway or cable to be supported.
5. Supports for Conductors in Vertical Conduit -- Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-

armored 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 malleable iron.

6. Structural Steel for Fabricated Supports and Restraints -- ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

C. Mounting Anchoring and Attachment Components -- Items for fastening electrical items, or their supports, to building surfaces including the following:

1. Powder-Actuated Fasteners: Threaded steel stud, for use in hardened portland cement, concrete, steel, or wood, with tension, shear and pullout capacities appropriate for the supported loads and building materials where used. Coordinate usage with General Contractor on precast structural members.

   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) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Stong-Tie Company Inc., Masterset Fastening Systems Unit.

2. Mechanical Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

   a. Available Manufacturers: Subject to the 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; a division of Cooper Industries.
      2) Empire Tool and manufacturing Company, Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable iron, slotted support system units similar to MSS, Type 18; comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All steel, spring head type.
7. Hanger rods: threaded steel.

D. Fabricated Metal Equipment Support Assemblies

1. Description: Welded or bolted, structural - steel shapes, shop or field fabricated to fit dimensions of supported equipment.
2. Materials: Comply with requirements in Division 5 Section, "Metal Fabrications" for steel shapes and plates.

E. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.

1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
2. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
5. Manufacturers:

a. Cooper B-Line, a division of Cooper Industries: www.cooperindustries.com.
b. PHP Systems/Design: www.phpsd.com.
c. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
d. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA101 for applications of hangers and supports for electrical equipment and systems except if requirements in this section are more stringent.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC and RMC as required by NFPA 70. Mininmum rod size shall be 1/4" in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25% in the future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

3.2 INSTALLATION

A. Supports

1. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
2. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

3. 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.
4. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
    a. To Wood: Fasten with lag screws or through bolts.
    b. To New Concrete: Bolt to concrete inserts.
    c. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
    d. To Existing Concrete: Expansion anchor fasteners.
    e. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
    f. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
    g. To Light Steel: Sheet metal screws.
    h. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
5. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

B. Installation of Fabricated Metal Supports
1. Comply with installation requirements in Division 5 Section "Metal Fabrications" for site-fabricated metal supports.
2. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
3. Field Welding: Comply with AWS D1.1/D1.1M

C. Concrete Bases
1. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
2. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 3.
3. Anchor equipment to concrete base.
    a. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    b. Install anchor bolts to elevations required for proper attachment to supported equipment.

c. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

D. Painting

1. Touchup: Comply with requirements in Division 9 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
2. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

E. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.

1. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
2. Obtain permission from Engineer before drilling or cutting structural members.

F. Rigidly weld support members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

G. Install surface-mounted cabinets and panelboards with minimum of four anchors.

H. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1 inch off wall.

I. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

END OF SECTION 260529

SECTION 260534 - CONDUIT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).

B. Aluminum rigid metal conduit (RMC).

C. Intermediate metal conduit (IMC).

D. PVC-coated galvanized steel rigid metal conduit (RMC).

E. Flexible metal conduit (FMC).

F. Liquid-tight flexible metal conduit (LFMC).

G. Electrical metallic tubing (EMT).

H. Rigid polyvinyl chloride (PVC) conduit.

I. Liquid-tight flexible nonmetallic conduit (LFNC).

J. Conduit fittings.

K. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete encasement of conduits.

B. Section 07 84 00 - Firestopping.

C. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC) and armored cable (Type AC), including uses permitted.

D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

E. Section 26 05 29 - Hangers and Supports for Electrical Systems.

F. Section 26 05 35 - Surface Raceways.

G. Section 26 05 37 - Boxes.

H. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

I. Section 26 27 01 - Electrical Service Entrance: Additional requirements for electrical service conduits.

1.3 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.

B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.

C. ANSI C80.5 - American National Standard for Electrical Rigid Aluminum Conduit (ERAC); 2005.

D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC); 2005.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

F. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); National Electrical Contractors Association; 2006.

G. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit; National Electrical Contractors Association; 2004.

H. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); National Electrical Contractors Association; 2003.

I. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2007.

J. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; National Electrical Manufacturers Association; 2005.

K. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; National Electrical Manufacturers Association; 2003.

L. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; National Electrical Manufacturers Association; 2004.

M. NEMA TC 7 - Smooth Wall Coilable Electrical Polyethylene Conduit and fittings; National Electrical Manufacturers Association, 2005. Comply with ASTM 2160 and UL 651B.

N. NEMA TC-14 - Reinforced Thermosetting Resin Conduit (RTRC) and fittings; National Electrical Manufacturers Association; 2002. UL 1684.

O. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

P. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.

Q. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

R. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.

S. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.

T. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.

U. UL 651 - Schedule 40 and 80 Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.

V. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

W. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

X. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
5. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

C. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

D. Product Data: Provide for metallic conduit, flexible metal conduit, liquid-tight flexible metal conduit, metallic tubing, nonmetallic conduit, flexible nonmetallic conduit, nonmetallic tubing, fittings, and conduit bodies.

1.6 QUALITY ASSURANCE

A. A. Conform to requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:

1. Under Slab on Grade: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.

6. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit.
7. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.

D. Embedded Within Concrete:

1. Within Slab on Grade (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
2. Within Slab Above Ground (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
3. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.

E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

F. Concealed Within Hollow Metal Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

1. Locations subject to physical damage include, but are not limited to:

a. Where exposed below 8 feet, except within electrical and communication rooms or closets.

K. Exposed, Exterior: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.

L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

M. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit or aluminum rigid metal conduit.

N. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
   1. Maximum Length: 6 feet.

O. Connections to Vibrating Equipment:
   1. Dry Locations: Use flexible metal conduit.
   2. Damp, Wet, or Corrosive Locations: Use liquid-tight flexible metal conduit.
   3. Maximum Length: 6 feet unless otherwise indicated.
   4. Vibrating equipment includes, but is not limited to:
      a. Transformers.
      b. Motors.

2.2 CONDUIT REQUIREMENTS

A. Electrical Service Conduits: Also comply with Section 26 27 01.

B. Communications Systems Conduits: Also comply with Section 27 05 28.

C. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

D. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.

E. Minimum Conduit Size, Unless Otherwise Indicated:
   1. Branch Circuits: 1/2 inch (16 mm) trade size.
   2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
   3. Control Circuits: 1/2 inch (16 mm) trade size.
   4. Flexible Connections to Luminaires: 3/8 inch (12 mm) trade size.
   5. Underground, Interior: 3/4 inch (21 mm) trade size.
   6. Underground, Exterior: 1 inch (27 mm) trade size.

F. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

B. Fittings:
   1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel or malleable iron.

3. Connectors and Couplings: Use threaded type fittings only. Thread-less set screw and compression (gland) type fittings are not permitted.

2.4 ALUMINUM RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.

B. Fittings:

1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use aluminum.
3. Connectors and Couplings: Use threaded type fittings only. Thread-less set screw and compression (gland) type fittings are not permitted.

2.5 INTERMEDIATE METAL CONDUIT (IMC)

A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

B. Fittings:

1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.
3. Connectors and Couplings: Use threaded type fittings only. Thread-less set screw and compression (gland) type fittings are not permitted.

2.6 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.

C. PVC-Coated Fittings:

1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.

D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

2.7 FLEXIBLE METAL CONDUIT (FMC)

A. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.

2.8 LIQUID-TIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.

C. Description: Interlocked steel construction with PVC jacket.

2.9 ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.
3. Connectors and Couplings: Use compression (gland) or set-screw type.

    a. Do not use indenter type connectors and couplings.

2.10 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

B. Fittings:

1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.11 LIQUID-TIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

A. Description: NFPA 70, Type LFNC liquid-tight flexible nonmetallic conduit listed and labeled as complying with UL 1660.

B. Fittings:

1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for the type of conduit to be connected.

2.12 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.

E. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify routing and termination locations of conduit prior to rough-in.

E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install aluminum rigid metal conduit (RMC) in accordance with NECA 102.

E. Install intermediate metal conduit (IMC) in accordance with NECA 101.

F. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.

G. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

H. Install liquidtight flexible nonmetallic conduit (LFNC) in accordance with NECA 111.

I. Conduit Routing:

1. Unless dimensioned, conduit routing indicated is diagrammatic.
2. When conduit destination is indicated and routing is not shown, determine exact routing required.
3. Conceal all conduits unless specifically indicated to be exposed.
4. Conduits in the following areas may be exposed, unless otherwise indicated:
   a. Electrical rooms.
   b. Mechanical equipment rooms.
   c. Within joists in areas with no ceiling.
5. Unless otherwise approved, do not route conduits exposed:
   a. Across floors.
   b. Across roofs.
   c. Across top of parapet walls.
   d. Across building exterior surfaces.
6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
7. Arrange conduit to maintain adequate headroom, clearances, and access.
8. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
9. Route conduits above water and drain piping where possible.
10. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
11. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
12. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to.
    a. Heaters.
    b. Hot water piping.
    c. Flues.
13. Group parallel conduits in the same area together on a common rack.

J. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.

K. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquid-tight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and rain-tight hubs for wet locations.
6. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

L. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

M. Underground Installation:

1. Minimum Cover, Unless Otherwise Indicated or Required:

   a. Underground, Exterior: 24 inches.
   b. Under Slab on Grade: 12 inches to bottom of slab.

2. Provide underground warning tape in accordance with Section 26 05 53 along entire conduit length for service entrance where not concrete-encased.

N. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):

1. Maximum Conduit Size: 1 inch (27 mm) unless otherwise approved.
2. Install conduits within middle one third of slab thickness.
3. Secure conduits to prevent floating or movement during pouring of concrete.

O. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 03 30 00 with minimum concrete cover of 3 inches on all sides unless otherwise indicated.

P. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:

1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where conduits are subject to earth movement by settlement or frost.

Q. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:

1. Where conduits pass from outdoors into conditioned interior spaces.
2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

R. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

S. Provide grounding and bonding in accordance with Section 26 05 26.

T. Identify conduits in accordance with Section 26 05 53.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

D. Correct deficiencies and replace damaged or defective conduits.

3.4 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.5 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION 260534

SECTION 260537 - BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wall and ceiling outlet boxes.

B. Floor boxes.

C. Pull and junction boxes.

1.2 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

C. Section 26 27 26 - Wiring Devices: Wall plates in finished areas.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

B. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2007.

C. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association; 2008.

D. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; National Electrical Manufacturers Association; 2008.

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.

F. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Project Record Documents: Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.5 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Provide products listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.

1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
2. Concrete Ceiling Boxes: Concrete type.

B. Nonmetallic Outlet Boxes: NEMA OS 2, for use in dwelling units in Type II, IV, and V construction.

C. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.

D. Wall Plates for Finished Areas: As specified in Section 26 27 26.

2.2 FLOOR BOXES

A. Floor Boxes: NEMA OS 1, fully adjustable, 1-1/2 inches deep.

B. Material: Cast metal.

C. Shape: Round.

D. Service Fittings: As specified in Section 26 27 26.

2.3 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.

B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.

C. Coordinate installation of outlet boxes for equipment connected under Section 26 27 17.

D. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

E. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.

1. Adjust box locations up to 10 feet if required to accommodate intended purpose.

F. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.

G. Maintain headroom and present neat mechanical appearance.

H. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

I. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

J. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

K. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

L. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

M. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

N. Use flush mounting outlet box in finished areas.

O. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

P. Provide separate boxes for emergency power and normal power systems.

Q. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

R. Locate outlet boxes so that wall plates do not span different building finishes.

S. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation.

1. Provide minimum 24 inches separation in acoustic rated walls.
2. Provide minimum 24 inches separation in fire rated walls.

T. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

U. Use stamped steel bridges to fasten flush mounting outlet box between studs.

V. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

W. Provide vapor sealing type boxes or additional vapor barrier enclosures around boxes located in exterior walls in wood or metal stud framing.

X. Use adjustable steel channel fasteners for hung ceiling outlet box.

Y. Do not fasten boxes to ceiling support wires.

Z. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.

AA. Use gang box where more than one device is mounted together. Do not use sectional box.

AB. Use gang box with plaster ring for single device outlets in Type I and II construction areas.

AC. Use cast outlet box in exterior locations exposed to the weather and wet locations.

AD. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.

AE. Set floor boxes level.

AF. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

AG. Identify boxes in accordance with Section 26 05 53.

3.2 ADJUSTING

A. Adjust floor boxes flush with finish flooring material.

B. Adjust flush-mounting outlets to make front flush with finished wall material.

C. Install knockout closures in unused box openings.

3.3 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

END OF SECTION 260537

SECTION 260548 – ELECTRICAL SEISMIC CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Seismic restraints from qualified seismic vibration isolator manufacturer for electrical equipment and conduit as required by local Building Code.

1.2 RELATED SECTIONS

A. Sections referenced by equipment requiring seismic restraint.

1.3 REFERENCE STANDARDS

A. NFPA-70.

B. Applicable Indiana Building Code.

C. Applicable local standards and regulations.

1.4 SYSTEM DESCRIPTION

A. System consists of furnishing and installing approved seismic restraints for all electrical equipment such as transformers, generators, motor control centers, unit substations switchboards, distribution panels, panelboards, similar electrical equipment, cable tray, bus duct, conduit 2-1/2 inches or larger, and pendant mounted light fixtures.

B. Seismic restraints are not required for the following conditions for conduit systems:
   1. Conduit suspended by individual hangers 12 inches (305 mm) or less in length from top of conduit to supporting structure.
   2. Conduit which has less than 2-1/2 inches inside diameter.
   3. Equipment with operating weight of less than 400 pounds unless noted otherwise.

C. Fabricate and install seismic restraints in accordance with details in Reference Standards.

D. Restrain equipment as follows:
   1. Securely anchor rigidly mounted equipment to floors or concrete housekeeping bases. Reinforce and dowel housekeeping pads as required by Reference Standards.
   2. Resiliently mounted equipment set on floor shall have isolators bolted to equipment and to floor or concrete housekeeping base. Reinforce and dowel housekeeping pads as required by Reference Standards. If isolators do not

provide the required resistance to lateral forces, provide additional support devices and/or snubbers as required.

3. Resiliently mounted equipment hung from structure shall have transverse and longitudinal cable bracing or snubbers if isolators do not provide required resistance to lateral forces. For factory package equipment where components are resiliently mounted within equipment, unit manufacturer shall furnish and install additional support devices and/or snubbers as required.
4. Utilize flexible connectors for conduit connections to all equipment.

1.5 SUBMITTALS

A. Reference Standards
   1. Submit list of all applicable standards for this geographic region and installation.

B. Shop Drawings and Product Data Sheets
   1. Engineering calculations done by professional engineer registered to practice in Project area and who is experienced in providing seismic engineering calculations and design of seismic Constraints.
   2. Equipment details, and installation and adjustment instructions.
   3. Information on devices required to provide restrained seismic isolation for all resiliently mounted equipment by vibration isolator manufacturer.

1.6 QUALITY ASSURANCE

A. Provide all required engineering calculations and furnish all required isolators, snubbers, grornmets, and related devices.

B. Provide all necessary installation instructions and supervise as necessary to ensure that completed installation is in accordance with manufacturers recommendations and requirements of these specifications.

C. Provide written certification to Architect/Engineer that completed installation is in accordance with manufacturer’s recommendations and requirements of local code authority and these specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Refer to specific sections of this specification for product requirements and acceptable manufacturers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locations of seismic restraints are not shown on drawings. As conduit and electrical equipment is being installed, determine locations for installation of lateral and longitudinal restraints required, and fabricate, furnish, and install them in accordance with details, schedules, and recommendations of Reference Standards.

B. Coordinate layout and installation of seismic constraints with other trades,

3.2 FIELD QUALITY CONTROL

A. Review installation of seismic restraints with local code official as work progresses and obtain approval of completed installation.

B. Engage qualified independent testing agency to test pull-out resistance of seismic anchorage devices.

C. If devices fail, modify installations and retest until said devices pass tests.

D. Record and submit all test results.

END OF SECTION 260548

SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Voltage markers.

E. Underground warning tape.

F. Floor marking tape.

G. Warning signs and labels.

1.2 RELATED REQUIREMENTS

A. Section 09 90 00 - Painting and Coating.

B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

C. Section 26 27 26 - Wiring Devices: Device and wallplate finishes; factory pre-marked wallplates.

1.3 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2007.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2007.

C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2009.

E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:

1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
2. Do not install identification products until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.7 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 - PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.

a. Switchboards:

1) Identify power source and circuit number. Include location when not within sight of equipment.

2) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

b. Panelboards:

1) Identify power source and circuit number. Include location when not within sight of equipment.
2) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
3) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
4) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.

c. Enclosed switches, circuit breakers, and motor controllers:

1) Identify power source and circuit number. Include location when not within sight of equipment.
2) Identify load(s) served. Include location when not within sight of equipment.

d. Time Switches:

1) Identify load(s) served and associated circuits controlled. Include location.

e. Enclosed Contactors:

1) Identify ampere rating.
2) Identify voltage and phase.
3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
4) Identify coil voltage.
5) Identify load(s) and associated circuits controlled. Include location.

f. Transfer Switches:

1) Identify power source and circuit number for both normal power source and standby power source. Include location when not within sight of equipment.

2. Service Equipment:

a. Use identification nameplate to identify each service disconnecting means.
b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
c. Use identification nameplate at each piece of service equipment to identify the available fault current and the date calculations were performed.

3. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.

4. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
5. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
6. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
7. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
8. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.
    a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches wide, painted in accordance with Section 09 90 00.
9. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
    a. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.

B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
3. Use underground warning tape to identify direct buried cables.

C. Identification for Raceways:
1. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet.
    a. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches wide.
        1) Color Code:
            (a) Fire Alarm System: Red.
        2) Field-Painting: Comply with Section 09 90 00.
        3) Vinyl Color Coding Electrical Tape: Comply with Section 26 05 19.
2. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
3. Use underground warning tape to identify underground raceways.

D. Identification for Boxes:

1. Use voltage markers or color coded boxes to identify systems other than normal power system.

   a. Color-Coded Boxes: Field-painted in accordance with Section 09 90 00 per the same color code used for raceways.

      1) Fire Alarm System: Red.

2. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.

   a. For exposed boxes in public areas, use only identification labels.

E. Identification for Devices:

1. Wiring Device and Wallplate Finishes: Comply with Section 26 27 26.
2. Use identification label to identify fire alarm system devices.
3. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
4. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Materials:

   a. Indoor Clean, Dry Locations: Use plastic nameplates.
   b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.

2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.

   a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.

3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:

1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:

1. Minimum Size: 1 inch by 2.5 inches.
2. Legend:
   a. System designation where applicable:
      1) Fire Alarm System: Identify with text "FIRE ALARM".
   b. Equipment designation or other approved description.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
   a. System Designation: 1 inch.
   b. Equipment Designation: 1/2 inch.
5. Color:
   a. Normal Power System: White text on black background.
   b. Fire Alarm System: White text on red background.

D. Format for General Information and Operating Instructions:

1. Minimum Size: 1 inch by 2.5 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch.
5. Color: Black text on white background unless otherwise indicated.

E. Format for Caution and Warning Messages:

1. Minimum Size: 2 inches by 4 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/2 inch.
5. Color: Black text on yellow background unless otherwise indicated.

F. Format for Receptacle Identification:

1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Power source and circuit number or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

G. Format for Control Device Identification:

1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Load controlled or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

H. Format for Fire Alarm Device Identification:

1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Designation indicated and device zone or address.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Red text on white background.

2.3 WIRE AND CABLE MARKERS

A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

C. Legend: Power source and circuit number or other designation indicated.

D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

E. Minimum Text Height: 1/8 inch.

F. Color: Black text on white background unless otherwise indicated.

2.4 VOLTAGE MARKERS

A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.

B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

C. Minimum Size:

1. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
2. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
3. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

D. Legend:

1. Markers for System Identification:

E. Color: Black text on orange background unless otherwise indicated.

2.5 UNDERGROUND WARNING TAPE

A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

B. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.

C. Legend: Type of service, continuously repeated over full length of tape.

D. Color:

2.6 FLOOR MARKING TAPE

A. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlaminate, 3 inches wide, with alternating black and white stripes.

2.7 WARNING SIGNS AND LABELS

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Signs:

1. Materials:
2. Minimum Size: 7 by 10 inches unless otherwise indicated.

C. Warning Labels:

1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
   a. Do not use labels designed to be completed using handwritten text.
2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 - PRODUCTS

3.1 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:

1. Surface-Mounted Equipment: Enclosure front.
2. Flush-Mounted Equipment: Inside of equipment door.

3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
4. Elevated Equipment: Legible from the floor or working platform.
5. Branch Devices: Adjacent to device.
6. Interior Components: Legible from the point of access.
7. Conduits: Legible from the floor.
8. Boxes: Outside face of cover.
9. Conductors and Cables: Legible from the point of access.
10. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.

G. Mark all handwritten text, where permitted, to be neat and legible.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 260553

SECTION 260583 – ELECTRICAL CONNECTIONS TO EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this Section.

B. This Section is a Division 26 Basic Materials and Methods Section and is part of each Division 22, 23 and 26 section making reference to electrical connections for equipment specified herein.

1.2 DESCRIPTION OF WORK

A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.

B. Applications of electrical power connections specified in this section include the following:

1. To motors.
2. To temperature control equipment

C. Electrical connections for equipment not furnished as integral part of equipment are specified in Divisions 22, 23 and other Division 26 sections, and are work of this section.

D. Motor starters and controllers not furnished as integral part of equipment are specified in applicable Division 26 sections.

E. Refer to Divisions 22 and 23 sections for motor starters and controllers furnished integrally with equipment.

F. Refer to Divisions 22 and 23 sections for connection requirements for temperature control equipment.

G. Junction boxes and disconnect switches required for connection motors and other electrical units of equipment are specified in applicable Division 26 sections.

1.3 QUALITY ASSURANCE

A. NEC Compliance. Comply with applicable requirements of NEC as to type of products used and installation of electrical power connections (terminals and splices) for junction boxes, motor starters, and disconnect switches.

B. ANSI Compliance. Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.

C. Compliance with Testing Laboratories. Comply with UL Std 486A, “Wire Connectors and Soldering Lugs for Use With Copper Conductors”, including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials that are listed and labeled by nationally-recognized testing laboratories.

1.4 SHOP DRAWINGS

A. Shop drawings are not required for work described in this section.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General: For each electrical connection indicated, provide complete assembly of materials, including, but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations.

B. Raceways and fittings. Provide raceways and fittings of types, grades, sizes, and weights (wall thicknesses) indicated for each type service. Provide products complying with Section 26 05 34.

C. Wires, Cables, and Connectors. Provide wires, cables, and connectors complying with Division 26 05 19 which are listed for use for the particular application.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect area and conditions under which electrical connections for equipment are to be installed and notify contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

3.2 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Install electrical connections as indicated, in accordance with equipment manufacturer’s written instructions, with recognized industry practices, and complying with applicable requirements of UL, NEC, and NECA’s “Standard of Installation” to ensure that products fulfill requirements.

B. Coordinate with other work, including wires/cables, raceway, and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connection for proper interface between electrical power supplies and installed equipment.

D. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating than, electrical insulation rating of those conductors being spliced.

E. Prepare cables and wires by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.

F. Trim cables and wires as short as practical and arrange routing to facilitate inspection, testing and maintenance.

G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torqueing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL's 486A.

H. Fasten identification markers to each electrical power supply wire/cable conductor in accordance with Division 26 Section "Electrical Identification". Affix markers on each terminal conductor as close as possible to the point of connection.

3.3 CONNECTIONS TO MOTORS

A. Make electrical connections to all motors, appliances, and other equipment and associated control devices in accordance with the schedules on the drawings and as hereinafter specified.

1. In each case, verify connections and physical data from approved shop drawing, manufacturer's wiring diagrams, and/or detail drawings provided by relevant trade subcontractor.
2. Generally, all motors and equipment will be furnished and set in place by others, and the electrical contractor shall make all connections thereto. Where indicated in schedules and specified, this contractor shall furnish and install starter, manual controls, and auxiliary equipment. This contractor shall furnish and install all disconnect switches required by code.

B. Provide liquid-tight flexible conduit for connection of motors and other electrical equipment where subject to movement and vibration. Flexible conduit connections shall be not less than 12" no more than 18".

C. When connecting adjustable speed drives (ASDs) to a motor, install the conductors from the drive to the motor in a separate raceway. Installing conductors in a common conduit or wireway is not acceptable.

3.4 CONNECTIONS TO TEMPERATURE CONTROL EQUIPMENT

A. Make electrical connections to temperature control equipment as indicated in the plans and specifications and according to the manufacturer's written instruction. Coordinate with the mechanical contractor.

3.5 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical connections and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site; then retest to demonstrate compliance.

END OF SECTION 260583

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 DEVICES

A. Outdoor Photoelectric Switches: Solid state, with DPST dry contacts rated for 1800-VA tungsten, to operate connected relay, contactor coils, and microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
2. Time Delay: 15-second minimum.
3. Surge Protection: Metal-oxide varistor.

B. Indoor, Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit complying with UL 773A, with separate relay unit rated for 20-A ballast load at 120- and 277-V ac. Cadmium sulfide photoresistors are not acceptable.

1. Type: Dual technology (passive infrared and ultrasonic).
2. Voltage: 120/277 V.
3. Switch Rating: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac.
4. Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.
5. Time Delay: Adjustable from 5 to 300 seconds.
6. Set-Point Adjustment: With deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
7. Indicator: Two LEDs.

C. Indoor, Wall-Switch Occupancy Sensors:

1. Type: Dual technology (passive infrared and ultrasonic).

2. Voltage: 120/277 V.
3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
4. Time Delay: Adjustable up to 30 minutes.
5. Field of View: 180 degrees.
6. Minimum Coverage Area: 900 sq. ft.

D. High Bay Occupancy Sensors:

1. Type: Dual technology (passive infrared and ultrasonic).
2. Voltage: 120/277 V.
3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
4. Time Delay: Adjustable up to 30 minutes.
5. Field of View: Aisle bi-directional or high bay 360 degrees based on installation location.
6. Minimum Coverage Area: 900 sq. ft.

E. Outdoor, Weatherproof Motion Sensors:

1. Type: Passive infrared.
2. Switch Rating:

   a. Lighting-Fixture-Mounted Sensor: 500-VA fluorescent.
   b. Separately Mounted Sensor: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac.

3. Voltage: 120/277 V.
4. Time Delay: Adjustable up to 15 minutes.
5. Detection Coverage: 180-degree field of view and 110-foot detection range.

F. Lighting Contactors: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

B. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

C. Label time switches and contactors with a unique designation.

D. Verify actuation of each sensor and adjust time delays.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Lighting and appliance panelboards.

B. Overcurrent protective devices for panelboards.

1.2 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 29 - Hangers and Supports for Electrical Systems.

C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification; Revision D, 2006.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

C. NECA 407 - Standard for Installing and Maintaining Panelboards; National Electrical Contractors Association; 2009.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2008.

E. NEMA PB 1 - Panelboards; National Electrical Manufacturers Association; 2006.

F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; National Electrical Manufacturers Association; 2007.

G. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2009.

H. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

K. UL 67 - Panelboards; Current Edition, Including All Revisions.

L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

M. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

N. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

O. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
   4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   5. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
   1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.

D. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.
2. Panelboard Keys: Two of each different key.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:

1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Siemens Industry, Inc: www.sea.siemens.com.

B. Eaton Corporation; Cutler-Hammer Products: www.eaton.com.

C. General Electric Company: www.geindustrial.com.

D. Schneider Electric; Square D Products: www.schneider-electric.us.

E. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 ALL PANELBOARDS

A. Provide products listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose indicated.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.
2. Ambient Temperature:

   a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

C. Short Circuit Current Rating:

1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings. (22,000 AIC)
2. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
3. Label equipment utilizing series ratings as required by NFPA 70.

D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

G. Bussing: Sized in accordance with UL 67 temperature rise requirements.

1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

   a. Indoor Clean, Dry Locations: Type 1.

2. Boxes: Galvanized steel unless otherwise indicated.

a. Provide wiring gutters sized to accommodate the conductors to be installed.
b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.

3. Fronts:

a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.

4. Lockable Doors: All locks keyed alike unless otherwise indicated.

J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

L. Provide the following features and accessories where indicated or where required to complete installation:

1. Feed-through lugs.
2. Sub-feed lugs.

2.3 LIGHTING AND APPLIANCE PANELBOARDS (HOUSE PANELS)

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:

1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
2. Main and Neutral Lug Type: Mechanical.

C. Bussing:

1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
2. Phase and Neutral Bus Material: Aluminum.
3. Ground Bus Material: Aluminum.

D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:

1. Provide surface-mounted or flush-mounted enclosures as indicated.
2. Provide clear plastic circuit directory holder mounted on inside of door.

2.4 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:

1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
   a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
      1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
   b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
   c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
3. Conductor Terminations:
   a. Provide mechanical lugs unless otherwise indicated.
   b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
6. Provide the following circuit breaker types where indicated.
   a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
   b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
   c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.
   d. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
7. Provide listed high intensity discharge lighting rated circuit breakers with HID marking for all branch circuits serving HID lighting.
8. Do not use tandem circuit breakers.
9. Do not use handle ties in lieu of multi-pole circuit breakers.

2.5 SOURCE QUALITY CONTROL

A. Factory test panelboards according to NEMA PB 1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install panelboards securely, in a neat and workmanlike manner in accordance with NECA 1 (general workmanship), NECA 407 (panelboards), and NEMA PB 1.1.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required supports in accordance with Section 26 05 29.

E. Install panelboards plumb.

F. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

G. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

H. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.

I. Provide grounding and bonding in accordance with Section 26 05 26.

J. Install all field-installed branch devices, components, and accessories.

K. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.

L. Provide filler plates to cover unused spaces in panelboards.

M. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:

1. Emergency and night lighting circuits.
2. Fire detection and alarm circuits.

3. Intrusion detection and access control system circuits.
4. Video surveillance system circuits.

3.3 FIELD QUALITY CONTROL

A. Perform inspection, testing, and adjusting in accordance with Section 01 40 00.

B. Inspect and test in accordance with NETA STD ATS, except Section 4.

C. Test GFCI circuit breakers to verify proper operation.

D. Test AFCI circuit breakers to verify proper operation.

E. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.5 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

2.2 COMMERCIAL-GRADE DEVICES

A. 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.

B. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.

C. Convenience Receptacles: NEMA WD 1, NEMA WD 6, Configuration 5-20R, and UL 498.

D. Duplex GFCI Convenience Receptacles: 125 V, 20 A, straight blade, feed-through type. NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. 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.

C. Select device colors and wall plates as follows:

1. For plastic covers, match device color.
2. Device plate color to match device. Provide stainless steel in warehouse, dock area, and wash room.

D. Mount devices flush, with long dimension vertical, and grounding terminal of receptacles on top unless otherwise indicated. Group adjacent devices under single, multigang wall plates.

END OF SECTION 262726

SECTION 262816 – DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 RELATED WORK

A. Transformers.

B. Secondary Grounding.

1.2 INDUSTRY STANDARDS

A. Equipment specified herein shall meet the applicable standards of the following agencies and associations.

1. Underwriters' Laboratories, UL.
2. Institute of Electrical and Electronic Engineers, IEEE.
3. National Electrical Manufacturers Association, NEMA.

1.3 SUBMITTALS

A. Furnish to the Architect shop drawings for the following items:

1. Safety switches.

B. All these items shall be by the same manufacturer as the switchboards and panel boards.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

A. Safety switches shall be heavy duty, fused unless noted otherwise, with number of poles, electrical characteristics, ratings and modifications as required. When used as service entrance equipment unit shall be labeled as such.

B. Switching mechanism shall be quick-make, quick-break, with handle that is padlockable in the "Off" position.

C. When safety switches are provided to control mechanical equipment it shall be Division 26 Contractor's responsibility to verify the number of poles needed and speed.

D. Enclosure shall be suitable for the area in which it is to be installed and shall have a defeatable door interlock which prevents the door from opening when the switch is "on".

E. Fusible units are to be equipped with current limiting fuses and shall have fuseholders with rejection clips to prevent other type fuses from being installed.

F. Safety switches shall be as manufactured by Siemens, Square D, General Electric, Westinghouse or Cutler-Hammer.

2.2 FUSES

A. Fuses shall be non-renewable with 200,000 amperes RMS symmetrical interrupting capacity.

1. Class RK5 units shall be non-renewable, time-delay type:
   a. Standards:
      Low-Peak; LPN-RK & LPS-RK - Bussman Co.
      Amp-Trap; TR-R and TRS-R - Gould-Shawmut Co.
      LON-RK and LOS-RK - CEFLO.
2. Class L units.
   a. Standards:
      LIMITRON; KRP-C - Bussman Co.
      AMP-TRAP; A4BY - Gould-Shawmut Co.
      CLL-CEFLO.
3. Class J units.
   a. Standards:
      Limitron; JKS - Bussman Co.
      Amp-Trap; A4J - Gould-Shawmut Co.
      CJS - CEFLO.

B. Provide the Owner with 10% or three (3) spare fuses, whichever is greater, of each size and type used on the Project.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Safety switches shall be installed where shown at 6’ from floor to top of switch, unless otherwise noted.

B. Install all items securely to walls, columns, or machine frames, and be responsible for all necessary brackets, mounting devices, structural pieces, anchors and/or inserts necessary for this purpose.

C. Do not mount equipment directly to masonry or concrete walls. Provide a 3/4” plywood panel on the wall and securely mount equipment on the plywood. Approved alternate method of mounting equipment is mounting equipment on strut. Approved manufacturers are: B-Line, Kindorf/Superstrut, Unistrut or approved equal.

END OF SECTION 262816

SECTION 262817 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Fusible Switches, 600 A and Smaller: UL 98 and NEMA KS 1, Type HD, that accommodate specified fuses, and with lockable handle interlocked with cover in closed position.

B. Nonfusible Switches, 600 A and Smaller: UL 98 and NEMA KS 1, Type HD, with lockable handle interlocked with cover in closed position.

C. Shunt Trip Switches: Comply with UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Description: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with field-adjustable instantaneous trip settings.
3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
4. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
5. GFEP Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.

B. Features and Accessories:

1. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
2. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.4 ENCLOSURES

A. NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Section 260500 "Common Work Results for Electrical."

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

END OF SECTION 262817

SECTION 265000 - LIGHTING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data for each luminaire, including lamps.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Per drawings.

2.2 PERFORMANCE REQUIREMENTS

A. Fixtures, Emergency Lighting Units, Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

E. Exterior Luminaires: Comply with UL 1598 and listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

F. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2.4 EXIT SIGNS

A. Internally Lighted Signs: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.

1. Lamps for AC Operation: LEDs, 70,000 hours minimum of rated lamp life.

2.5 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
4. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate ceiling-mounted luminaires with ceiling construction, mechanical work, and security and fire-prevention features mounted in ceiling space and on ceiling.

B. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

C. Comply with NFPA 70 for minimum fixture supports.

D. Seismic Protection: Luminaire attachments to building walls and ceilings shall comply with seismic criteria in Section 260500 "Common Work Results for Electrical."

E. Suspended Lighting Fixture Support:

1. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
2. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

F. Air-Handling Fixtures: Install with dampers closed and ready for adjustment.

G. Adjust aimable lighting fixtures to provide required light intensities.

END OF SECTION 265000

SECTION 283100 – FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fire alarm system design and installation, including all components, wiring, and conduit.

B. Transmitters for communication with supervising station.

C. Maintenance of fire alarm system under contract for specified warranty period.

1.2 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware: Electrically operated locks and door holder devices to be monitored and released by fire alarm system.

B. Section 21 13 00 - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.

C. Section 14 20 10 - Passenger Elevators: Elevator systems monitored and controlled by fire alarm system.

D. Section 23 33 00 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

1.3 REFERENCE STANDARDS

A. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits; 2002 (R2008).

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. NFPA 72 - National Fire Alarm Code and Signaling Code; 2010.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Evidence of designer qualifications.

C. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:

1. Copy (if any) of list of data required by authority having jurisdiction.
2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
4. System zone boundaries and interfaces to fire safety systems.
5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
7. List of all devices on each signaling line circuit, with spare capacity indicated.
8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
11. Certification by the manufacturer of the control unit that the system design complies with the contract documents.
12. Certification by Contractor that the system design complies with the contract documents.

D. Evidence of installer qualifications.

E. Evidence of instructor qualifications; training lesson plan outline.

F. Evidence of maintenance contractor qualifications, if different from installer.

G. Inspection and Test Reports:

1. Submit inspection and test plan prior to closeout demonstration.
2. Submit documentation of satisfactory inspections and tests.
3. Submit NFPA 72 "Inspection and Test Form," filled out.

H. Operating and Maintenance Data: See Section 01 78 00 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:

1. Complete set of specified design documents, as approved by authority having jurisdiction.
2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
4. List of recommended spare parts, tools, and instruments for testing.
5. Replacement parts list with current prices, and source of supply.
6. Detailed troubleshooting guide and large scale input/output matrix.
7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.

8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

I. Project Record Documents: See Section 01 78 00 for additional requirements; have one set available during closeout demonstration:

1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
2. "As installed" wiring and schematic diagrams, with final terminal identifications.
3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.

J. Closeout Documents:

1. Certification by manufacturer that the system has been installed in compliance with his installation requirements, is complete, and is in satisfactory operating condition.
2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
3. Maintenance contract.

K. Maintenance Materials, Tools, and Software: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.5 QUALITY ASSURANCE

A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.

B. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.

1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.

C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

1.6 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 5 years after date of Substantial Completion.

C. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Fire Alarm Control Units - Basis of Design: SimplexGrinnell; 4100ES: www.simplexgrinnell.com.

B. Fire Alarm Control Units - Other Acceptable Manufacturers: Provided their products meet or exceed the performance of the basis of design product, products of the following are acceptable:

1. Honeywell Security & Fire Solutions/Gamewell-FCI: www.gamewell-fci.com.
2. Honeywell Security & Fire Solutions/Notifier: www.notifier.com.
3. Honeywell Security & Fire Solutions/Silent Knight: www.silentknight.com.
4. Siemens Building Technologies, Inc: www.sbt.siemens.com.
5. Provide all control units made by the same manufacturer.

C. Substitutions: See Section 01 60 00 - Product Requirements.

1. For other acceptable manufacturers of control units specified, submit product data showing equivalent features and compliance with contract documents.

2.2 FIRE ALARM SYSTEM

A. Fire Alarm System: Provide a new automatic addressable fire detection and alarm system:

1. Provide all components necessary, regardless of whether shown in the contract documents or not.
2. Protected Premises: Entire building shown on drawings.
3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:

a. The Americans With Disabilities Act (ADA).
b. The requirements of the local authority having jurisdiction.
c. Applicable local codes.
d. The contract documents (drawings and specifications).

e. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.

4. Evacuation Alarm: Single smoke zone; general evacuation of entire premises.
5. Combined Systems: Do not combine fire alarm system with other non-fire systems.

B. Supervising Stations and Fire Department Connections:

1. Remote Supervising Station: UL-listed central station under contract to facility.
2. Means of Transmission to Remote Supervising Station: Digital alarm communicator transmitter (DACT), 2 telephone lines.

C. Circuits:

1. Initiating Device Circuits (IDC): Class B, Style A.
2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.
3. Notification Appliance Circuits (NAC): Class B, Style W.

D. Spare Capacity:

1. Initiating Device Circuits: Minimum 25 percent spare capacity.
2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
3. Master Control Unit: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.

E. Power Sources:

1. Primary: Dedicated branch circuits of the facility power distribution system.
2. Secondary: Storage batteries.
3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.

2.3 FIRE SAFETY SYSTEMS INTERFACES

A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:

1. Sprinkler water control valves.
2. Dry-pipe sprinkler system pressure.
3. Manual Station.
4. Fire Standpipe System.
5. System Smoke Detector.

B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:

1. Sprinkler water flow.
2. Elevator lobby, elevator hoistway, and elevator machine room smoke detectors.

C. Elevators:

1. Elevator lobby, hoistway, and machine room smoke detectors: Elevator recall for fire fighters' service.

D. HVAC:

1. Area Smoke Detectors/Duct Smoke Detectors: Close dampers individually by associated smoke detector/duct smoke detector activation; shut down air handlers indicated, located in each MU & RTU.
2. Fire/smoke and smoke dampers in this building are provided by Mechanical Contractor. These dampers have a 120 volt electric actuator.
3. Provide 120 volt power from nearest power panel to power all fire/smoke dampers. Connect as many dampers to each branch circuit so the circuit is loaded to no more than 70% of its capacity.

E. Doors:

1. Smoke Barrier Door Magnetic Holders: Release upon activation of smoke detectors in smoke zone on either side of door, upon alarm from manual pull station on same floor, and upon sprinkler activation on same floor.

2.4 COMPONENTS

A. GENERAL:

1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.

B. FIRE ALARM CONTROL PANEL (FACP)

1. General: Comply with UL 864, "Control Units for Fire-Protective Signaling Systems."
2. The following FACP hardware shall be provided:
   a. Power Limited base panel with red cabinet and door, 120 VAC input power.
   b. 2,000 point capacity where (1) point equals (1) monitor (input) or (1) control (output).
   c. 2,000 points of Network Annunciation at FACP Display when applied as a Network Node.
   d. 2000 points of annunciation where one (1) point of annunciation equals:
      1) 1 LED driver output on a graphic driver or 1 switch input on a graphic switch input module.
      2) 1 LED on panel or 1 switch on panel.
   e. From all battery charging circuits in the system provide battery voltage and ammeter readouts on the FCP LCD Display.
   f. Municipal City Circuit Connection with Disconnect switch, 24VDC Remote Station (reverse polarity), local energy, shunt master box, or a form "C" contact output.
   g. One Auxiliary electronically resetable fused 2A @24VDC Output, with programmable disconnect operation for 4-wire detector reset.
   h. One Auxiliary Relay, SPDT 2A @32VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.
   i. Three (3) Class B or A (Style Y/Z) Notification Appliance Circuits (NAC; rated 3A@24VDC, resistive).

j. Four (4) form "C" Auxiliary Relay Circuits (Form C contacts rated 2A @ 24VDC, resistive), operation is programmable for trouble, alarm, supervisory of other fire response functions. Relays shall be capable of switching up to ½ A @ 120VAC, inductive.
k. The FACP shall support (6) RS-232-C ports and one service port.
l. Remote Unit Interface: supervised serial communication channel for control and monitoring of remotely located annunciators and I/O panels.
m. Programmable DACT for either Common Event Reporting or per Point Reporting.
n. Service Port Modem for dial in passcode access to all fire control panel information.

3. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures.
4. Alphanumeric Display and System Controls: Panel shall include an 80 character LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands. 4100-315 Specifications

C. AUTOCALL SYSTEM INTERFACE

1. When a fire alarm system using existing Autocall XA loop devices requires expansion FACP shall be capable of interfacing to the XA loop via an interface module. This module shall allow the FACP to be selected to function as either the XA loop master controller (head end) or as a Data Gathering Panel as an intelligent device on the XA loop reporting to a remote master controller. Multiple XA Loop Interface Modules can be installed in the FACP allowing a variety of system expansion situations to be satisfied.

D. REMOTE LCD ANNUNCIATOR

1. Provide where required a remote LCD Annunciator with the same "look and feel" as the FACP operator interface. The Remote LCD Annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys, Status LEDs and LCD Display as the FACP.
2. Annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with four (4) programmable control switches and associated LEDs.
3. Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.
4. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.
5. The LCD shall display the following information relative to the abnormal condition of a point in the system:

a. 40 character custom location label.
b. Type of device (e.g., smoke, pull station, waterflow).
c. Point status (e.g., alarm, trouble).

6. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACP.

E. EMERGENCY POWER SUPPLY

1. General: Components include battery, charger, and an automatic transfer switch.
2. Battery: Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm indicating devices in alarm or supervisory mode for a period of 15 minutes.

F. ADDRESSABLE MANUAL PULL STATIONS

1. Description: Addressable single- or double-action type, red LEXAN, with molded, raised-letter operating instructions of contrasting color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units.
2. Protective Shield: Where indicated on drawings, provide a tamperproof, clear LEXAN shield and red frame that easily fits over manual pull stations. When shield is lifted to gain access to the station, a battery powered piercing warning horn shall be activated. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.

G. SMOKE SENSORS

1. General: Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:

   a. Factory Nameplate: Serial number and type identification.
   b. Operating Voltage: 24 VDC, nominal.
   c. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
   d. Plug-In Arrangement: Sensor and associated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. Base shall provide break-off plastic tab that can be removed to engage the head/base locking mechanism. No special tools shall be required to remove head once it has been locked. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control unit.
   e. Each sensor base shall contain an LED that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the sensor base LED shall be on steady.
   f. Each sensor base shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.
   g. Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for

photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.

h. The sensor's electronics shall be immune from false alarms caused by EMI and RFI.

i. Sensors include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACP. Sensor address shall be located in base to eliminate false addressing when replacing sensors.

j. Removal of the sensor head for cleaning shall not require the setting of addresses.

2. Type: Smoke sensors shall be of the photoelectric or combination photoelectric / heat type. Where acceptable per manufacturer specifications, ionization type sensors may be used.

3. Bases: Relay output, sounder and isolator bases shall be supported alternatives to the standard base.

4. Duct Smoke Sensor: Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Sensor includes relay as required for fan shutdown.

a. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct sensor shall be provided by the FACP.

b. The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable. Relay shall be mounted within 3 feet of HVAC control circuit.

c. Duct Housing shall provide a relay control trouble indicator Yellow LED.

d. Compact Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.

e. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.

f. Duct Housing shall provide a magnetic test area and Red sensor status LED.

g. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.

h. Each duct sensor shall have a Remote Test Station with an alarm LED and test switch.

i. Where indicated provide a NEMA 4X weatherproof duct housing enclosure shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.

H. HEAT SENSORS

1. Thermal Sensor: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; 135-deg F fixed-temperature setting except as indicated.

2. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.
3. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and] programmable to operate at 135-deg F or 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACP for either 15-deg F or 20-deg F per minute.
4. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.

I. ADDRESSABLE CIRCUIT INTERFACE MODULES

1. Addressable Circuit Interface Modules: Arrange to monitor one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of evacuation indicating appliances and AHU systems.
2. Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line or a separate two wire pair running from an appropriate power supply as required.
3. There shall be the following types of modules:

   a. Type 1: Monitor Circuit Interface Module:

      1) For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. The supervision of the zone wiring will be Class B. This module will communicate status (normal, alarm, trouble) to the FACP.
      2) For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACP.

   b. Type 2: Line Powered Monitor Circuit Interface Module

      1) This type of module is an individually addressable module that has both its power and its communications supplied by the two wire multiplexing signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACP.
      2) This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire signaling line circuit shall supply power and communications to the module.

   c. Type 3: Single Address Multi-Point Interface Modules

      1) This multipoint module shall provide location specific addressability for four initiating circuits and control two output relays from a single

address. Inputs shall provide supervised monitoring of normally open, dry contacts and be capable of communicating four zone status conditions (normal, open, current limited, and short). The input circuits and output relay operation shall be controlled independently and disabled separately.

2) This dual point module shall provide a supervised multi-state input and a relay output, using a single address. The input shall provide supervised monitoring of two normally open, dry contacts with a single point and be capable of communicating four zone status conditions (normal, open, current limited, and short). The two-wire signaling line circuit shall supply power and communications to the module.

3) This dual point module shall monitor an unsupervised normally open, dry contact with one point and control an output relay with the other point, using a single address. The two-wire signaling line circuit shall supply power and communications to the module.

d. Type 4: Line Powered Control Circuit Interface Module

1) This module shall provide control and status tracking of a Form "C" contact. The two-wire signaling line circuit shall supply power and communications to the module.

e. Type 5: 4-20 mA Analog Monitor Circuit Interface Module

1) This module shall communicate the status of a compatible 4-20 mA sensor to the FACP. The FACP shall annunciate up to three threshold levels, each with custom action message; display and archive actual sensor analog levels; and permit sensor calibration date recording.

4. All Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACP. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

J. ADDRESSABLE ALARM NOTIFICATION APPLIANCES

1. Addressable Notification Appliances: The Contractor shall furnish and install Addressable Notification Appliances and accessories to operate on compatible signaling line circuits (SLC).

a. Addressable Notification appliance operation shall provide power, supervision and separate control of horns and strobes over a single pair of wires. The controlling channel (SLC) digitally communicates with each appliance and receives a response to verify the appliance's presence on the channel. The channel provides a digital command to control appliance operation. SLC channel wiring shall be unshielded twisted pair (UTP), with a capacitance rating of less than 60pf/ft and a minimum 3 twists (turns) per foot.

b. Class B (Style 4) notification appliances shall be wired without requiring traditional in/out wiring methods; addressable "T" Tapping shall be permitted. Up to 63 appliances can be supported on a single channel.
c. Each Addressable notification appliance shall contain an electronic module and a selectable address setting to allow it to occupy a unique location on the channel. This on-board module shall also allow the channel to perform appliance diagnostics that assist with installation and subsequent test operations. A visible LED on each appliance shall provide verification of communications and shall flash with the appliances address setting when locally requested using a magnetic test tool.

2. Addressable Controller: Addressable Controller shall supervise Channel (SLC) wiring, communicate with and control addressable notification appliances. It shall be possible to program the High/Lo setting of the audible (horn) appliances by channel from the addressable controller.
3. Horn: Addressable horn shall be listed to UL 464. Horn appliances shall have a High/Lo Setting, programmable by channel from the addressable controller or by appliance from the host FACP. The horn shall have a minimum sound pressure level of 83 or 89 dBA @ 24VDC. The horn shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot.
4. Visible/Only: Addressable strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. V/O appliances shall be provided with different minimum flash intensities of 15cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.
5. Audible/Visible: Addressable combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe. The horn shall have a minimum sound pressure level of 83 or 89 dBA @ 24VDC. The audible/visible enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. The appliance shall be capable of two-wire synchronization with one of the following options:

   a. Synchronized Strobe with Horn on steady.
   b. Synchronized Strobe with Temporal Code Pattern on Horn.
   c. Synchronized Strobe with March Time cadence on Horn.
   d. Synchronized Strobe firing to NAC sync signal with Horn silenced.

6. Speaker/Visible: Combination Speaker/Visible (S/V) units combine the speaker and visible functions into a common housing. The S/V shall be listed to UL 1971 and UL 1480. Addressable functionality controls visible operation, while the speaker operates on a 25VRMS or 70.7VRMS NAC.

   a. Twisted/shielded wire is required for speaker connections on a standard 25VRMS or 70.7VRMS NAC using and UTP conductors, having a

minimum of 3 twists per foot is required for addressable strobe connections.

b. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet.

c. The S/V shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for General Signaling.

d. The S/V installs directly to a 4" square, 1 1/2 in. deep electrical box with 1 1/2" extension.

7. Isolator Module: Isolator module provides short circuit isolation for addressable notification appliance SLC wiring. Isolator shall be listed to UL 864. The Isolator shall mount directly to a minimum 2 1/8" deep, standard 4" square electrical box, without the use of special adapter or trim rings. Power and communications shall be supplied by the Addressable Controller channel SLC; dual port design shall accept communications and power from either port and shall automatically isolate one port from the other when a short circuit occurs. The following functionality shall be included in the Isolator module:

   a. Report faults to the host FACP.
   b. On-board Yellow LED provides module status.
   c. After the wiring fault is repaired, the Isolator modules shall test the lines and automatically restore the connection.

8. Accessories: The contractor shall furnish the necessary accessories.

K. NAC Power Extender

1. The IDNet NAC Power Extender panel shall be a stand-alone panel capable of powering a minimum of 4 notification appliance circuits. Notification appliance circuits shall be Class B Style Y rated at 2 amps each. Panel shall provide capability to be expanded to 8 notification appliance circuits.
2. The internal power supply & battery charger shall be capable of charging up 12.7 Ah batteries internally mounted or 18Ah batteries mounted in an external cabinet.
3. The NAC extender panel may be mounted close to the host control panel or can be remotely located. The IDNET Addressable NAC Extender Panel when connected to an addressable panel shall connect to the host panel via an IDNet communications channel. Via the IDNET channel each output NAC can be individually controlled for general alarm or selective area notification.
4. For IDNet connected NAC extender panels up to five panels can be connected on a single IDNet channel.
5. When connected to a conventional (non-addressable panel) one or two standard notification appliance circuits from the main control panel may be used to activate all the circuits on the NAC power extender panel.
6. Alarms from the host fire panel shall signal the NAC power extender panel to activate. The panel shall monitor itself and each of its NACs for trouble conditions and shall report trouble conditions to the host panel.

L. Circuit Conductors: Copper; power limited plenum rated; color code and label.

M. Dwelling Units: 120V stand-alone combination photo-electric smoke detector and carbon monoxide detector, with battery backup and sounder for alarm.

1. Comply with UL 217; suitable for NFPA 101, residential occupancies; operating at 120-V ac. Smoke detectors shall be powered from nearest receptacle branch circuit within room.
2. Auxiliary Relays: One Form A and one Form C, both rated at 0.5 A.
3. Audible Notification Appliance: Piezoelectric sounder rated at 90 dBA at 10 feet (3 m) according to UL 464.
4. Test Switch: Push to test; simulates smoke at rated obscuration.
5. Tandem Connection: Allow tandem connection of number of indicated detectors; alarm on one detector shall actuate notification on all connected detectors.
6. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
7. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
8. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.

N. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.

1. Equipment Connected to Alternating Current Circuits: Maximum let through voltage of 350 V(ac), line-to-neutral, and 350 V(ac), line-to-line; do not use fuses.

O. Storage Cabinet for Spare Parts and Tools: Steel with baked enamel finish, size appropriate to quantity of parts and tools.

1. Padlock eye and hasp for lock furnished by Owner.
2. Locate as directed by Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and the contract documents.

B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.

C. Obtain Owner's approval of locations of devices, before installation.

D. Install instruction cards and labels.

E. Install and connect Fire Dept. Connection Horn and Light furnished by Sprinkler Contractor.

F. Install Fire Alarm System per construction phasing. Coordinate with Owner.

3.2 INSPECTION AND TESTING FOR COMPLETION

A. Notify Owner 7 days prior to beginning completion inspections and tests.

B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.

D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.

E. Provide all tools, software, and supplies required to accomplish inspection and testing.

F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

G. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.3 OWNER PERSONNEL INSTRUCTION

A. Provide the following instruction to designated Owner personnel:

1. Hands-On Instruction: On-site, using operational system.

B. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:

1. Initial Training: 1 session pre-closeout.

C. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

3.4 CLOSEOUT

A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.

1. Be prepared to conduct any of the required tests.
2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
3. Have authorized technical representative of control unit manufacturer present during demonstration.
4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
5. Repeat demonstration until successful.

B. Occupancy of the project will not occur prior to Substantial Completion of each associated phase.

C. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:

1. Approved operating and maintenance data has been delivered.
2. Spare parts, extra materials, and tools have been delivered.
3. All aspects of operation have been demonstrated to Owner.
4. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
5. Specified pre-closeout instruction is complete.

3.5 MAINTENANCE

A. See Section 01 70 00 - Execution Requirements, for additional requirements relating to maintenance service.

B. Provide to Owner, at no extra cost, a written maintenance contract for entire manufacturer's warranty period, to include the work described below.

C. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:

1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
3. Record keeping required by NFPA 72 and authorities having jurisdiction.

D. Provide trouble call-back service upon notification by Owner:

1. Provide on-site response within 2 hours of notification.
2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

E. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.

F. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.

G. Comply with Owner's requirements for access to facility and security.

END OF SECTION 283100

SECTION 311005 – EROSION CONTROL

PART 1 - GENERAL

1.1 SCOPE

A. This Section provides the general guidelines for the control of erosion and sediment for this project. Control of sedimentation for construction site shall be accomplished through utilization of a variety of control practices. The complexity of the erosion and sediment control plan will vary depending upon individual site conditions. The goal of the erosion control plan is to limit the quantity of sediment leaving the construction site. The erosion control plan has been approved by the Soil and Water Conservation District.

In addition, the Contractor must also comply with Rule 5 (327 IAC 15-5) for land alteration which disturbs one (1) acre or more, as is the case with this project.

1.2 PERMITTING REQUIREMENTS

A. The Owner has submitted a soil erosion control plan to the local LPA and IDEM for approval prior to beginning land disturbing activities. Copies of all applications, letters of intent, submittals, plans and other erosion and sediment control related information shall be supplied by the Owner and kept onsite throughout the construction period.

1.3 DESIGN GUIDELINES

A. In order to fully achieve an acceptable level of erosion and sediment control on the construction site, the following design principles shall be fully adhered to during the construction process.

1. Existing natural vegetation should remain undisturbed for as long as possible during the construction activities. Naturally vegetated areas along property lines, jurisdictional wetlands, lakes, and watercourses, both natural and man-made, should be left undisturbed during all phases of the site construction. These vegetative filter strips were made a part of the rezoning approval.

2. A logical sequencing of site construction activities must be provided in order to minimize the size of exposed land areas, and the length of time land areas are left without some form of temporary or permanent soil protection.

3. The dry basins to be constructed on the property shall be initially overdug to act as sediment traps during the initial phases of the work. From this time on all site runoff shall be directed through these basins so that they can act as secondary clarifiers.

4. Soil stockpiles shall be stabilized utilizing either vegetative establishment, sediment trapping barriers, or erosion control measures such as tarping or mulching, singly or in combination.

5. Storm sewer inlets that are made operable either before or during the construction phase of development shall be provided with protection from siltation.

6. Stable, properly maintained construction traffic access routes and stream crossings shall be identified on the site erosion and sediment control plan as needed. These construction access routes shall be installed as part of the site perimeter sediment control barriers, prior to the initiation of on-site land alteration activities. Where sediment is transported onto public street or road surfaces, these streets or roads shall be cleaned thoroughly at the end of each day. Sediment shall be removed by scraping, shoveling or sweeping and be transported to a controlled fill area. Street washing will be allowed only when approved in writing by the Engineer/Architect.

7. Post permit at construction entrance as required by permit.

8. Runoff velocities shall be kept as low as possible.

9. A thorough maintenance and follow-up program, and identification of the person(s) responsible for its implementation will be required.

1.4 INDIANA STORM WATER QUALITY MANUAL

A. The latest edition of the Indiana Storm Water Quality Manual shall be used for detailed technical guidance as it applies to the development of all control plans:

1. Perimeter Control - Perimeter control measures shall be installed as specified on the approved plan, including: construction access drives, straw bale dams and fabric fencing, temporary sediment traps, sediment basins and diversions.

2. Vegetative Control - Disturbed areas which are at finish grade shall be permanent seeded within seven (7) days. At the discretion of the Soil and Water Conservation District and/or MS4, barren areas to be rough graded and left undisturbed for more than fourteen (14) days shall be established with temporary vegetation; and dormant seeding will be required during seasonal periods (October through February) for those barren areas to be left undisturbed for one hundred twenty (120) days or longer.

3. Slope Protection - Slope protection shall be provided by use of temporary and permanent diversion levees, vegetative cover and slope drains. Concentrated stormwater flows shall not be allowed to flow down cut or fill slopes without proper slope stabilization.

4. Sediment Trapping - To achieve the goal of preventing sediment from leaving the construction site, the Soil and Water Conservation District will require the use of sediment barriers such as fabric fencing, straw bale dams and sediment basins.

5. Protection of Outlet Channel - Concentrated stormwater runoff leaving a development site shall be outletted to an open channel, storm sewer pipe or culvert which is capable of receiving this discharge. Runoff velocities shall be controlled

during all storm events so that the peak runoff velocity during and after the completion of the land alteration approximates existing conditions.

6. The principles and practices provided by the State in Rule 5 are to be followed in the construction period. Rule 5 does not give specific requirements for use of various practices leaving that to the localities. Individual practices can be modified or waived upon request to the Engineer based on special site characteristics and conditions.

PART 2 – PRODUCTS (not used)

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install initial protection in accordance with the drawings.

B. Change – retrofit erosion control measures on a day to day basis to achieve maximum possible protection and minimal erosion.

C. A trained individual must perform an inspection of all erosion control measures by the end of the next business day following a rain event of one-tenth of an inch or more and, at minimum, one time per week. Make necessary corrections to BMPs. Follow-up with written documentation of findings and corrective measures addressing the following:

1. Maintenance of existing storm water quality measures to ensure they are functioning properly and identify additional measures necessary to remain in compliance with this Rule 5 and all applicable statutes and rules.
2. Inspections shall be documented and records shall be maintained (until the Notice of Termination (NOT) has been filed) by the Contractor.
3. All evaluation reports for the project site must be made available to the local and/or state agencies within 48 hours of a request. Records shall include at a minimum the date, the inspector's name, the maintenance and corrections needed based on this inspection, and the status of previously identified deficiencies and details of corrective actions recommended and completed.

D. Clean, bale out, reinforce existing erosion control (Best Management Practices) on an as needed basis.

END OF SECTION 311005

SECTION 312000 – EARTH MOVING (SITE)

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work required under this section consists of all excavation, backfilling, and related items and compaction necessary to complete the work indicated on the plans and specified herein.

PART 2 - PRODUCTS

2.1 EMBANKMENT MATERIAL

A. Granular fill: Bank run sand or crushed sand free from organic matter and debris, approved by the Owner/Engineer and/or testing lab.

B. Selected fill: Clean, excavated material, free from stones larger than six inches, organic matter, or other unsuitable material, and not frozen or of improper moisture content.

2.2 UNSUITABLE MATERIAL

A. Highly organic soil, ASTM D2487, Group PT, top soil, roots, vegetable matter, trash and debris.

B. Rubble: The term "rubble" as used herein is defined as brick or brick pieces which were left from the demolition of prior buildings.

2.3 TOPSOIL

A. Topsoil removed for excavation shall be stockpiled on site.

B. Topsoil shall consist of loose, friable soil, free of refuse, roots over one inch in diameter, rocks over two inches in diameter, brush, weeds or other material which would be detrimental to proper development of vegetative growth. Topsoil shall have a pH value of 6.2 to 7.4.

2.4 MODIFIED SOIL MIXTURE

A. A homogenous blend of native topsoil and granular fill (bank run sand) as defined above.

2.5 BEDDING

A. Artificially graded mixture of natural or crushed gravel, crushed stone and/or natural crushed sand, ASTM D 2940, except with 100% passing 1” sieve and not more than 8% passing a No. 200 sieve.

2.6 DRAINAGE AGGREGATE

A. Refer to Section 02398.

2.7 CLAY MATERIAL

A. Soil classified as a clay or silty clay capable of providing a permeability coefficient (K) no greater than 10^{-6} cm/sec.

2.8 COMPACTING EQUIPMENT

A. For predominantly granular soil placed in up to 12" lifts: rolling drum, vibrating compactors.

B. For predominantly granular soil placed in not more than 8" lifts: pneumatic tired, wobble wheel rollers, loaded to not less than 325 pounds per rated inch of tire width.

C. For clay fills: sheep's foot roller consisting of staggered rows of feet projecting not less than 7" from drum, and loaded to produce at least 200 pounds per square inch of tamping area in contact with the ground.

D. For compacting around concrete pedestals and next to foundation walls: in granular soil use hand operated vibrating compactors, and in clay soil use Barco rammer type.

PART 3 - EXECUTION

3.1 PREPARATION

A. Inspection

1. Contractor shall carefully determine exact location of existing underground structures and utilities both known and unknown.
2. If damaged or broken by Contractor, such structures shall be repaired or replaced at Contractor's expense.

B. Unsuitable Materials:

Remove unsuitable material from within the limits of the work in this section and remove from site.

C. Standard subgrade treatment shall consist of disking the top 12 inches of soil, aerating and recompacting to the required compaction density in accordance with INDOT standard specifications.

D. Special subgrade treatment, if required, shall be in accordance with Section 02250 – Lime Stabilization.

3.2 TRENCHING

A. Excavate trench to permit installation of pipe at lines and grades indicated on Drawings.

B. Excavate trench only so far in advance of pipe placement as contractor can finish in one day.

C. Trenches shall be of sufficient width to provide space for proper placement of pipe, jointing and placement of backfill around and under pipe.

D. Remove any unsafe, unstable materials that may cause problems for the laying operation.

3.3 EXCAVATING

A. Rough grading

1. Where grading is to be done and topsoil is apparent, the topsoil will be stripped and stockpiled in a logical area where it will be out of the way and easily recovered. The depth in each case will be found by sampling, and this determined depth may then be removed to a depth of six (6) inches. If required, additional depth of topsoil may be removed upon agreement of the Owner, Engineer and the Contractor. If rock is encountered in rough grading, adjustment of elevations will be made where possible. If it becomes necessary to remove rock, the Contractor shall provide a price per cubic yard for any anticipated rock removal. Otherwise, it is assumed that there will be no additional charge. The Contractor shall be responsible for this determination in each case, and shall submit to the Engineer for decision on any unusual circumstance. All topsoil is to be kept free from subsoil and debris. All rubbish, stones, roots, stumps, etc., shall be removed from the site. All excavation shall be made as required to bring the site to rough grade six (6) inches below finish grade elevations shown on the drawings or to the subgrade of walks, drives, or other paved areas. All areas required to be filled in order to bring same to the grade shown on the drawings shall be filled to the subgrade of paved areas or to subgrade six (6) inches below finished grade as shown on drawings. Upon completion of the filling operation, the entire site shall be brought to subgrade six (6) inches below the elevations shown on the grading plan, except as may otherwise be necessary under roads, walks or other paved areas. Fills, other than building pads and areas to receive pavement, shall be free of debris and compacted to ninety percent (90%) of the original soil. All debris shall be removed from the area before finish grading. Abrupt changes in slope shall be rounded. The Contractor shall maintain adequate drainage of surface water during construction from all areas on the site, whether included in his work or not. Fill shall be placed in six (6) inch layers and compacted with caterpillar tractor, tamping roller, or sheep's foot roller.
2. Fill material in the top twelve (12) inches of the fill shall contain no stones more than four (4) inches in diameter. Fills shall be compacted with equipment approved by the Engineer. The soil shall be treated and worked so as to be damp but not wet. If

tamping rollers are used, ten (10) or more passes will be required on each layer as directed by the Engineer. Fill in areas under roads or paved area shall be compacted to not less than ninety-five percent (95%) maximum density at optimum moisture as determined by ASTM D-698. Borrow areas, if required, in addition to proposed lake excavations and other cuts shown on the plans, shall be approved by the Engineer.

3. All excavated rock shall be buried on the site. Rock found or placed under paved areas shall have a minimum cover of two (2) feet of clean material. All other areas where rock is placed shall have a one (1) foot cover.

B. Finish Grading

1. When other site work has been substantially completed, and when notified to proceed by the Engineer, Contractor shall finish grade all areas to be seeded under this contract. Finish grading is to consist of the work necessary to bring the surface of the soil to a smooth, true and even surface, with no water-holding pockets, acceptable to the Engineer. Areas to be finish graded shall be brought to a smooth and harmonious grade by the use of motor patrol grader or other approved mechanical means.
2. Finished grades are shown on the Drawings with profiles, solid contour lines and/or spot elevations.
3. Redistribute the stockpiled topsoil to the final contours shown on the site grading plan. Remove unsuitable extraneous material: sticks, roots, stones, etc.
4. Finish grading shall be carried out upon completion of all other site preparation work in a given area.
5. If it is found necessary to excavate deeper than indicated in order to reach firm ground, do said work only upon written order from the Owner/Engineer (approved in writing by the Owner) stipulating the cost.
6. Any excess excavated material shall be removed from the site or disposed of as noted on the plans or as directed by the Owner/Engineer.

3.4 EXISTING TILE LINES

The Contractor shall seal all tile lines broken in the course of excavation and not required for service thereafter. If there are tile lines that need to be extended, the Contractor shall receive approval of the Engineer before proceeding. All tiles shall be repaired with SDR 26 PVC pipe having the same diameter as that being replaced, and jointed to the existing pipe with Fernco Rubber type adapters banded with stainless steel clamps.

3.5 BACKFILL

A. Backfill to Grade Under Improved Surfaces:

1. Material: Sand Fill
2. Place and compact backfill under existing and future sidewalk location.

B. Backfill to Grade Not Under Improved Surfaces:

1. Material: Select Fill

2. Place and Compact backfill leaving small mound to allow for settlement.
3. Place topsoil a minimum of 6” on all areas to be seeded. The Contractor shall furnish all topsoil needed to meet this minimum depth requirement. If sufficient quantities of topsoil are not available on site, the remainder needed shall be acquired from an approved offsite borrow source.

C. Excess Backfill Material

1. Excess backfill material not required shall be removed from the site.

3.6 COMPACTION

A. Compact each layer of fill according to minimum density requirements listed below, expressed in percent of maximum dry density at optimum water content, determined by ASTM D1557-70 (modified proctor), method A or C, depending on material used.

For all fill materials: 95% beneath paved areas and 90% for the areas to remain lawn

B. In Place Soil Density Test: ASTM D1556 or Nuclear Method.

C. Owner may request a proof roll to verify compaction. Proof roll shall be accomplished with specialized proof rolling equipment or a tri-axial truck load to the Engineers discretion. Any proof roll requested shall be performed at the Contractor's expense.

3.7 FIELD QUALITY CONTROL

A. The Contractor will employ a qualified Test Lab to furnish the soils engineering services required for testing and inspections specified for this project with approval from Owner/Engineer.

B. Tests will be performed at the following locations and frequencies:

1. Paved areas: At subgrade and at each compacted lift, at least one test for every 1000 square feet.
2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 250 feet or less of trench length, but no fewer than two tests.
3. Building Pads: At the corner of each building pad at 100 foot spacings, or no less than five for the total building.

B. The Test Lab will make all tests of materials to determine their suitability for compaction and optimum water content, and will supervise continuously the placing of fill and backfill as directed by Owner/Engineer.

C. The representatives of the Test Lab and the Owner/Engineer shall have the power of rejection of materials, equipment or operating procedures.

D. The contractor shall replace, rework, or correct work which does not meet the specifications as directed by the Test Lab and/or the Owner/Engineer.

END OF SECTION 312000

SECTION 313116 - TERMITE CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Soil treatment with termiticide.
   2. Bait-station system.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include the EPA-Registered Label for termiticide products.

B. Product certificates.

C. Soil Treatment Application Report: Include the following:
   1. Date and time of application.
   2. Moisture content of soil before application.
   3. Termiticide brand name and manufacturer.
   4. Quantity of undiluted termiticide used.
   5. Dilutions, methods, volumes used, and rates of application.
   6. Areas of application.
   7. Water source for application.

D. Bait-Station System Application Report: Include the following:
   1. Location of areas and sites conducive to termite feeding and activity.
   2. Plan drawing showing number and locations of bait stations.
   3. Dated report for each monitoring and inspection occurrence indicating level of termite activity, procedure, and treatment applied before time of Substantial Completion.
   4. Termiticide brand name and manufacturer.
   5. Quantities of termiticide and nontoxic termite bait used.
   6. Schedule of inspections for one year from date of Substantial Completion.

E. Warranties: Sample of special warranties.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who employs workers trained and approved by manufacturer to install manufacturer's products.

B. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.

B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

C. Install bait-station system during construction to determine areas of termite activity.

1.5 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
   1. Warranty Period: Three years from date of Substantial Completion.

1.6 MAINTENANCE SERVICE

A. Continuing Service: Beginning at Substantial Completion, provide 12 months' continuing service including monitoring, inspection, and re-treatment for occurrences of termite activity. Provide a standard continuing service agreement. State services, obligations, conditions, terms for agreement period, and terms for future renewal options.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.
   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. BASF Corporation, Agricultural Products; Termidor.
      b. Bayer Environmental Science; Premise 75.

c. FMC Corporation, Agricultural Products Group; Dragnet FT Talstar Prevail.
d. Syngenta; Demon TC Prelude Probuild TC.
e.

2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than three years against infestation of subterranean termites.
3.

PART 3 - EXECUTION

3.1 APPLICATION, GENERAL

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.2 APPLYING SOIL TREATMENT

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

B. Proceed with application only after unsatisfactory conditions have been corrected.

C. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

D. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.
1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
3. Crawlspaces: Soil under and adjacent to foundations as previously indicated. Treat adjacent areas including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.

4. Masonry: Treat voids.
5. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.

E. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

F. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

G. Post warning signs in areas of application.

H. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.3 INSTALLING BAIT-STATION SYSTEM

A. Place bait stations according to the EPA-Registered Label for the product and manufacturer's written instructions, in the following areas that are conducive to termite feeding and activity:
1. Conducive sites and locations indicated on Drawings.
2. In and around infested trees and stumps.
3. In mulch beds.
4. Where wood directly contacts soil.
5. Areas of high soil moisture.
6. Near irrigation sprinkler heads.
7. Each area where roof drainage system, including downspouts and scuppers, drains to soil.
8. Along driplines of roof overhangs without gutters.
9. Where condensate lines from mechanical equipment drip or drain to soil.
10. At plumbing penetrations through ground-supported slabs.
11. Other sites and locations as determined by licensed Installer.

END OF SECTION 313116

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Driveways.
2. Roadways.
3. Parking lots.
4. Curbs and gutters.
5. Walks.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For each exposed product and for each color and texture specified.

C. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.3 QUALITY ASSURANCE

A. Ready-Mix-Concrete 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.

B. ACI Publications: Comply with ACI 301 unless otherwise indicated.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.

B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

D. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

E. Deformed-Steel Wire: ASTM A 496/A 496M.

F. Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.

G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified.

2.2 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150, gray portland cement Type I. Supplement with the following:

a. Fly Ash: ASTM C 618, Class C.

B. Normal-Weight Aggregates: ASTM C 33, Class 4S, uniformly graded. Provide aggregates from a single source.

C. Water: Potable and complying with ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

2.3 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.5 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

2.6 PAVEMENT MARKINGS

A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes.

1. Color: As indicated.

B. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.

1. Color: As indicated.

2.7 WHEEL STOPS

A. Wheel Stops: Precast, air-entrained concrete

1. Color: Gray.
2. Dowels: Galvanized steel, 3/4 inch in diameter, 10-inch minimum length.
3. Adhesive: As recommended by wheel stop manufacturer for application to concrete pavement.

2.8 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, with the following properties:

1. Compressive Strength (28 Days): 4000 psi
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.

3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: 5-1/2 percent plus or minus 1.5 percent.

B. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

C. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd..

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.4 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, to match jointing of existing adjacent concrete paving:

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

A. Moisten subbase to provide a uniform dampened condition at time concrete is placed.

B. Comply with ACI 301 requirements for measuring, mixing, transporting, placing, and consolidating concrete.

C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

D. Screed paving surface with a straightedge and strike off.

E. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.6 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
   1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.7 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by curing compound

3.8 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/2 inch.
4. Joint Spacing: 3 inches.
5. Contraction Joint Depth: Plus 1/4 inch, no minus.
6. Joint Width: Plus 1/8 inch, no minus.

3.9 PAVEMENT MARKING

A. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.

B. Sweep and clean surface to eliminate loose material and dust.

C. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.10 WHEEL STOPS

A. Install wheel stops in bed of adhesive applied as recommended by manufacturer.

B. Securely attach wheel stops to paving with not less than two galvanized-steel dowels located at one-quarter to one-third points. Install dowels in drilled holes in the paving and bond dowels to wheel stop. Recess head of dowel beneath top of wheel stop.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321320 – COMPACTED AGGREGATE BASE

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work required under this Section consists of all crushed stone paving, subgrade preparation and related items necessary to complete the work indicated on the plans and specified herein.

1.2 QUALITY ASSURANCE

A. All areas shall be installed as hereinafter specified

1.3 JOB CONDITIONS

A. Weather Limitations:

1. No mixture shall be placed when ambient temperature is at or below 35 degrees.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate shall be No. 8 stone or No. 53 stone in accordance with Section 904.02 of the Indiana Department of Highways Standard Specifications.

B. Aggregate properties shall comply with local highway standards

1. Soundness - max. pot. weighted loss - 12
2. Abrasion (L.A. abrasion) - 40
3. Friable particles - 0.2

C. Coarse Aggregate Sizes

SIEVE SIZE	No. 53 STONE	NO. 8 STONE
	TOTAL PERCENT PASSING	TOTAL PERCENT PASSING
1-1/2"	100	--
1"	80-100	100
3/4"	70-90	75-95
1/2"	55-80	40-70

3/8"	--	20-50
No. 4	35-60	0-15
No. 8	25-50	0-10
No. 30	12-30	--
No. 200	5-10	--

PART 3 - EXECUTION

3.1 APPLICATION

A. Subgrade shall be prepared and maintained as specified in Section 02221, or as noted on plans and shall be maintained free of all irregularities.

B. Handling and transporting of materials shall be performed so as to prevent segregation and loss of moisture.

C. Spreading Mixtures:

1. The compacted depth of stone placement shall be no less than two inches nor more than six inches. The mixture shall be spread in uniform layers to a depth that will produce the compacted uniform layers to a depth that will produce the compacted thickness specified with an approved spreading and leveling device.
2. Unless otherwise directed by the Engineer, each layer shall be shaped by a long base, blade-type, road machine and immediately compacted.
3. Each layer shall meet the density requirements at the time the next layer is placed thereon.

D. Compacting Aggregate:

1. Stone shall be compacted to a density equal to or greater than 97% maximum dry density as determined by ASTM D-1557-71.
2. Minimum required for compaction equipment shall be at least one tandem or three-wheel, self-propelled weighing no less than 10 tons on one self-propelled pneumatic time roller or sufficient weight to exert a contact pressure of not less than 50 to 90 psi.
3. Hand tamping shall be required for compacting the base adjacent to curbs or over other areas inaccessible to paver equipment. Tamper minimum weight no less than 50 pounds and surface area not less than 100 square inches.

E. The compacted surface shall not deviate in line or grade more than 1/2" and excess deviation shall be scarified, remixed and recompacted.

END OF SECTION 321320

SECTION 334100 – STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Field Inspection

1. Engineer will inspect all piping and appurtenances for soundness and infiltration.
2. Engineer will reject all materials found to have cracks, flaws or other defects. Promptly remove all defective materials from the site.

B. Final Acceptance

1. Sewer system shall have a minimum amount of infiltration, and slope sufficient to give a minimum velocity of two feet per second when the pipe is flowing full, based on an "N" coefficient of 0.013 in Manning's formula.
2. Pipe found to have loose joints or showing any visible evidence of leakage will not be accepted.
3. Sewers shall be straight between manholes and true to grade.

1.2 JOB CONDITIONS

A. Handling Material Into the Trench

Use the proper implements, tools, and facilities satisfactory to the Engineer for the safe and convenient prosecution of the work. Carefully lower all pipe and fittings into the trench piece by piece by means of a derrick or other suitable materials, tools, or equipment in such a manner as to prevent damage to material. Do not drop off dump materials into the trench.

B. Unsuitable Conditions

Do not lay pipe in water or upon frozen subgrades, or at any time or condition when, in the opinion of the engineer trench conditions are unsuitable.

PART 2 - PRODUCTS

2.1 PIPE

A. Concrete Pipe (Traffic Areas) Class III in Accordance with ASTM C-76 (latest edition).

B. PVC Sewer Pipe and Fittings – ASTM D 3034, SDR 26; Bell & spigot ends for gasketed joints.

C. HDPE Sewer Pipe shall be ADS-N12 Mega Green ST IB Pipe, ASTM F2648.

2.2 STORM WATER TREATMENT UNIT

A. Hooded structures using a snout type structure which will act as a baffle to capture trash. Also, a catch area constructed below the outlet pipe to capture grit.

2.3 BACKFILL

A. Granular Fill

B. Selected Fill

2.4 MANHOLES

A. Cast-In-Place Concrete - 3500 psi

B. Precast Reinforced Concrete manhole sections - ASTM C 478.

C. Precast "Moorbase" Sections.

D. Joints: O-ring rubber gasket joints - ASTM C 443 with performed joint filter strip and with both interior and exterior of joint to be grouted with Portland Cement Mortar.

E. Manhole Castings: Manhole Frame and Cover: ASTM A 48, latest edition, Class 20 with 24 inch diameter lid. One coat of bituminous paint required on all castings.

1. Traffic Areas: 7 inch minimum height, 400 pound minimum weight, equal to East Jourdan 1022-3.
2. Non-traffic Areas: 4 inch minimum height, 285 pound minimum weight, equal to East Jourdan 1022-1.
3. NOTE: Above castings shall apply except where Drawings indicate otherwise.

2.5 CURB INLETS AND AREA DRAINS

A. Cast-In-Place Concrete - 3500 psi

B. Curing Material - Liquid Membrane - C 309, Type 1.

C. Precast Catch Basins - ASTM C 76.

D. Inlet Frames and Grates - ASTM A 48, latest edition.

E. Curb inlets: East Jourdan 7030 casting w/type M4 vane grate and T-2 back for roll curbs; T-1 back for standing curb.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Alignment and Grade

Lay and maintain all pipe at the required lines and grades shown on the drawings.

B. Laying Pipe

1. Lay pipe in finished trenches commencing at the lowest point so that spigots point in the direction of flow and the bell ends point opposite the direction of flow.
2. Lay all pipe with ends abutting and true to line and grade. Fit and match pipe so that when laid it forms a sewer with a smooth uniform invert.
3. Check invert elevation of the pipe immediately upon completion of the joint to assure that it is properly laid to grade and alignment.
4. Place a rubber stopper or other approved device in the open ends of the pipe at all times when pipe laying is not actually in progress.

C. Pipe Connections: Regardless of connection type shown, all connections of PVC pipe to concrete structures will require a band type water stop be installed on the pipe prior to grouting the pipe in place.

1. Connections of New Sewer to Existing Sewer Mains
   a. Connect new sewer pipe from structures to the existing sewer main with a wye branch or by cutting into the side of the sewer pipe and patching with a grouted concrete collar.
   b. Exercise caution in making connection to avoid damage to existing mains which are to remain in service.
2. Connection of New Sewer Pipe to Existing Manholes or Inlets
   a. Connect new sewer pipe into existing structure by cutting into the side of the structure at the invert elevation shown on the drawings.
   b. Patch interior and exterior of existing structure with a grouted concrete collar.
3. Connection of New Inlets to Existing Sewer Laterals
   a. Cut old sewer pipe at a section as close as practical to the removed inlet or catch basin so that a tight connection may be made at this section.
   b. When removing portions of the existing sewer pipe, provide a neat junction with the extension and leave undamaged that portion of the existing sewer pipe remaining in service.
   c. Repair any damage to the portion remaining in service.
   d. Make connection of new concrete pipe to inlet or existing sewer line with a grouted concrete collar to prevent leakage.
4. Construction of Manholes
   a. Construct manholes true to line and grade at location indicated on drawings in accordance with the details shown on drawings.
   b. Poured Concrete Base Sections
      (1) Moisten subgrade if needed prior to concrete placement.
      (2) During placement, concrete shall be thoroughly spaded, vibrated or tamped.

(3) Form smooth invert channels and shape to a semi-circular bottom to a depth of the inside diameter of the adjacent sewer pipe. Slope manhole shelf towards channel at 12:1. Minimum base overhand-6 inches. For changes in direction of the sewers and entering branches, use a circular curve of as large a radius as the manhole will permit.

5. Construction of Inlets and Area Drains
   a. Construct all inlets and area drains in accordance with the details shown on the drawings and at the elevations and locations so indicated or established by the Engineer.
   b. Grout pipe entering structures around the connection to prevent leakage.
   c. Install casting true to lines and grades indicated on drawings.

3.2 TESTING

A. Deflection Testing Flexible Pipe

1. All storm sewer constructed of flexible pipe, including pipe manufactured from Polyvinyl Chloride (PVC), High Density Polyethylene (HDPE) and Corrugated Metal Pipe (CMP), shall be inspected or tested for deflection as follows:
   a. Pipes sized 36 inches or smaller in diameter, that cannot be inspected and measured for deflection with video cameras, visual inspection, or manual measurement to the satisfaction of the Engineer to determine less than 5 percent deflection, shall be tested using a mandrel.
   b. The mandrel shall be pulled by hand without mechanical assistance, and the mandrel test shall be a “go/no-go” procedure.
   c. The mandrel shall be approved by the Engineer, or his/her authorized representative, prior to use to certify that the mandrel is rigid, nonadjustable, has an odd number of legs not less than nine, and has a length not less than its nominal diameter.
   d. The diameter of the mandrel at any point shall not be less than the allowed percentage of deflection of the certified actual mean inside diameter of the pipe being tested.
   e. The mandrel shall be fabricated of metal, fitted with pulling rings at each end, stamped or engraved on some segment other than a runner with the nominal pipe size and the mandrel’s outside diameter.
   f. For any vertical or horizontal deflection test, pipe failure shall be defined as 5 percent or greater deflection of the tested pipe’s internal diameter.
   g. The Project Site Owner/Operator shall perform or shall cause to be performed, all required deflection tests no sooner than 30 days after final backfill has been placed over the pipe to be tested.
   h. Pipe inspection and test methods, procedures, and equipment, whether conducted or employed for mandrel testing or other inspections necessary to comply with this section, shall be subject to the Engineer or his/her authorized representative.
   i. The pipe inspection and test results must be reviewed and certified by the Engineer or his/her authorized representative prior to final acceptance or release of the storm sewer facilities and applicable portion of the letter of credit covering the storm sewer and associated improvements.

j. All flexible pipe failing the deflection test within the warrantee period shall be replaced or caused to be replaced by the Project Site Owner or operator at no cost to the Owner.
k. For flexible pipes larger than 36 inches diameter, inspection, measurement, and determination of deflection shall be achieved by methods and procedures approved by the Engineer.
l. The cost associated with all testing shall be included in the Bid.

END OF SECTION 334100

SECTION 334105 – SLEEVES AND CASINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Sleeves for utility lines beneath walks and streets.
2. Steel casings for utility lines beneath highways (bore and jack or directional bore).

PART 2 – PRODUCTS

2.1 JOINING MATERIALS

A. Solvent Cements for Joining Plastic Piping:

1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

B. Welds for steel casings/minimum casing lengths equals 20 feet.

2.2 SLEEVES

A. PVC Pipe: ASTM D 1785, Schedule 40, 6”.

B. Steel casing:

1. Minimum yield point strength: 35,000 psi, shall conform to ASTM A-53, Grade B, Type E or ASTM A-139, Grade B without hydrostatic test.
2. Minimum wall thickness 0.375 for highway crossings; 0.406 for railroad crossings.

2.3 IDENTIFICATION

A. Contractor to etch score line on back of all curbs and both sides of sidewalks

PART 3 – EXECUTION

3.1 PLASTIC PIPING SYSTEMS – COMMON REQUIREMENTS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install sleeves for pipes passing below walks and streets.

1. Cut sleeves 4' longer than the edge of walk, curb or pavement

C. Cap all PVC sleeve with PVC Schedule 40 caps glued in place.

3.2 STEEL CASING PIPES

A. Install as part of a directional bore or bore and jack operation.

B. Use necessary controls and measures to maintain line and grade shown on plans.

C. Use approved shims or blocking to correct minimum or deviations in plan grade and to hold carrier pipe securely within casing.

D. Install end seal using neoprene material, wrap held in place with stainless steel bands or a link seal type assembly installed inside of pipe.

E. For pipe lines intended to convey potentially explosive gases or where otherwise required by permitting agencies, install at each end of casing vertical steel vent piping to allow for safe exit any gas that would otherwise be trapped in annulus between outer casing and carrier pipe.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements.

B. Ream ends of pipes and tubes and remove burrs.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. For Plastic Pipe, Plastic Piping Solvent-Cement Joints: Cleaned 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.

E. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3213.

F. Steel Pipe: Weld in accordance with the appropriate AWS Standards.

G. Spacers manufacturer shall be Power Lonestar or other approved polyethylene blocking.

H. Manufacturer for Casing end seals shall be Linkseal or a neoprene wrap held in place with stainless steel bands, such as Cascade Waterworks Manufacturing,CCES end seals with T-304 stainless steel bands.

END OF SECTION 334105

SECTION 334600 - SUBDRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes subdrainage systems for the following:

1. Foundations.
2. Underslab areas.
3. Retaining walls.
4. Landscaped areas.

B. Related Sections include the following:

1. Division 07 waterproofing Sections for molded-sheet drainage panels.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. HDPE: High-density polyethylene plastic.

C. PE: Polyethylene plastic.

D. PP: Polypropylene plastic.

E. PS: Polystyrene plastic.

F. PVC: Polyvinyl chloride plastic.

G. Subdrainage: Drainage system that collects and removes subsurface or seepage water.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Perforated-wall pipe and fittings.
2. Solid-wall pipe and fittings.

3. Drainage conduits.
4. Drainage panels.
5. Geotextile filter fabrics.

B. Approval of waterproofing manufacturer's service agent for use of drainage panels against and for waterproofing membrane protection.

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to the "Piping Applications" Article in Part 3 for applications of pipe, tube, fitting, and joining materials.

2.3 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated PE Pipe and Fittings:

1. NPS 6 and Smaller: ASTM F 405 or AASHTO M 252, Type CP; corrugated, for coupled joints.
2. NPS 8 and Larger: ASTM F 667; AASHTO M 252, Type CP; or AASHTO M 294, Type CP; corrugated; for coupled joints.
3. Couplings: Manufacturer's standard, band type.

B. Perforated PVC Sewer Pipe and Fittings: ASTM D 2729, bell-and-spigot ends, for loose joints.

2.4 SOLID-WALL PIPES AND FITTINGS

A. PE Pipe and Fittings: AASHTO M 294, Type S, corrugated, with smooth waterway, for coupled joints.

1. Couplings: AASHTO M 294, corrugated, band type, matching tubing and fittings.

B. PVC Sewer Pipe and Fittings: ASTM D 3034, SDR 35, bell-and-spigot ends, for gasketed joints.

1. Gaskets: ASTM F 477, elastomeric seal.

2.5 SPECIAL PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant metal tension band and tightening mechanism on each end.

1. 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.

2. Unshielded Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant metal tension band and tightening mechanism on each end.
3. Shielded Flexible 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.

2.6 CLEANOUTS

A. PVC Cleanouts: ASTM D 3034, PVC cleanout threaded plug and slip joint pipe hub.

2.7 SOIL MATERIALS

A. Backfill, drainage course, impervious fill, and No. 8 stone or approved equal.

2.8 GEOTEXTILE FILTER FABRICS

A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.

1. Structure Type: Nonwoven, needle-punched continuous filament.
2. Style(s): Flat or sock.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.

B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.3 PIPING APPLICATIONS

A. Underground Subdrainage Piping:

1. Perforated PE pipe and fittings, couplings, and coupled joints.
2. Perforated PVC sewer pipe and fittings for loose, bell-and-spigot joints.

B. Underslab Subdrainage Piping:

1. Perforated PE pipe and fittings, couplings, and coupled joints.
2. Perforated PVC sewer pipe and fittings and loose, bell-and-spigot joints.

C. Header Piping:

1. PE drainage tubing and fittings, couplings, and coupled joints.
2. PVC sewer pipe and fittings, couplings, and coupled joints.

3.4 CLEANOUT APPLICATIONS

A. In Underground Subdrainage Piping:

1. At Grade in Earth: PVC cleanouts.
2. At Grade in Paved Areas: Cast-iron cleanouts.

B. In Underslab Subdrainage Piping:

1. In Equipment Rooms and Unfinished Areas: Cast-iron cleanouts.
2. In Finished Areas: Copper-alloy cleanouts.

3.5 FOUNDATION DRAINAGE INSTALLATION

A. Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed. Place and compact impervious fill to dimensions indicated, but not less than 6 inches deep and 12 inches wide.

B. Place impervious fill on subgrade adjacent to bottom of footing and compact to dimensions indicated, but not less than 6 inches deep and 12 inches wide after concrete footing forms have been removed.

C. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

D. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.

E. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive and tape.

F. Install drainage piping as indicated in Part 3 "Piping Installation" Article for foundation subdrainage.

G. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.

H. After satisfactory testing, cover drainage piping to width of at least 6 inches on side away from footing and above top of pipe to within 12 inches of finish grade.

I. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.

J. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.

K. Do not use drainage panels as protection for waterproof membrane unless approved by factory-authorized service representative of waterproofing membrane manufacturer. Submit approval if so used.

L. Place initial backfill material over compacted drainage course . Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

3.6 UNDERSLAB DRAINAGE INSTALLATION

A. Excavate for underslab drainage system after subgrade material has been compacted but before drainage course has been placed. Include horizontal distance of at least 6 inches between drainage pipe and trench walls. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.

D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive and tape

E. Install drainage piping as indicated in Part 3 "Piping Installation" Article for underslab subdrainage.

F. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.

G. After satisfactory testing, cover drainage piping with drainage course to elevation of bottom of slab, and compact and wrap top of drainage course with flat-style geotextile filter fabric.

H. Install horizontal drainage panels as follows:

1. Coordinate placement with other drainage materials.
2. Lay perforated drainage pipe at inside edge of footings.
3. Place drainage panel over drainage pipe with core side up. Peel back fabric and wrap fabric around pipe. Locate top of core at bottom elevation of floor slab.
4. Butt additional panels against other installed panels. If panels have plastic flanges, overlap installed panel with flange.

3.7 PLAZA DECK DRAINAGE INSTALLATION

A. Horizontal Drainage Panel: Install between slab and floor cover. Place core on structural floor. Install panels to fit tightly around floor drains of building's storm drainage system. Provide stormwater access into floor drain.

1. Install drainage piping as indicated in Part 3 "Piping Installation" Article for plaza deck subdrainage.

B. See Division 32 Section "Unit Paving."

3.8 RETAINING-WALL DRAINAGE INSTALLATION

A. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

B. Place supporting layer of drainage course over compacted subgrade to compacted depth of not less than 4 inches.

C. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive and tape.

D. Install drainage piping as indicated in Part 3 "Piping Installation" Article for retaining-wall subdrainage.

E. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.

F. After satisfactory testing, cover drainage piping to width of at least 6 inches on side away from footing and above top of pipe to within 12 inches of finish grade.

G. Place drainage course in layers not exceeding 3 inches in loose depth; compact each layer placed and wrap top of drainage course with flat-style geotextile filter fabric.

H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.

I. Fill to Grade: Place satisfactory soil fill material over compacted drainage course . Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish grade.

3.9 LANDSCAPING DRAINAGE INSTALLATION

A. Provide trench width to allow installation of drainage conduit. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.

D. Install drainage conduits as indicated in Part 3 "Piping Installation" Article for landscaping subdrainage with horizontal distance of at least 6 inches between conduit and trench walls. Wrap drainage conduits without integral geotextile filter fabric with flat-style geotextile filter fabric before installation. Connect fabric sections with adhesive and tape.

E. Add drainage course to top of drainage conduits.

F. After satisfactory testing, cover drainage conduit to within 12 inches of finish grade.

G. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.

H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.

I. Fill to Grade: Place satisfactory soil fill material over drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish grade.

3.10 PIPING INSTALLATION

A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.

1. Foundation Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 36 inches unless otherwise indicated.
2. Underslab Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent.
3. Plaza Deck Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 1.0 percent.
4. Retaining-Wall Subdrainage: When water discharges at end of wall into stormwater piping system, install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 36 inches, unless otherwise indicated. However, when water discharges through wall weep holes, pipe may be installed with a minimum slope of zero percent.
5. Landscaping Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 36 inches, unless otherwise indicated.
6. Lay perforated pipe with perforations down.
7. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.

B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

C. Install ABS piping according to ASTM D 2321.

D. Install PE piping according to ASTM D 2321.

E. Install PVC piping according to ASTM D 2321.

F. Install clay piping according to ASTM C 12 and NCPI's "Clay Pipe Engineering Manual."

G. Install concrete piping according to ACPA's "Concrete Pipe Handbook."

3.11 PIPE JOINT CONSTRUCTION

A. Cast-Iron Soil Pipe and Fittings: Hub and spigot, with rubber compression gaskets according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook." Use gaskets that match class of pipe and fittings.

B. Join ABS pipe and fittings according to ASTM D 2751.

C. Join PE pipe, tubing, and fittings with couplings for soil-tight joints according to AASHTO's "Standard Specifications for Highway Bridges," Division II, Section 26.4.2.4, "Joint Properties."

D. Join perforated, PE pipe and fittings with couplings for soil-tight joints according to AASHTO's "Standard Specifications for Highway Bridges," Division II, Section 26.4.2.4, "Joint Properties"; or according to ASTM D 2321.

E. Join PVC pipe and fittings according to ASTM D 3034 with elastomeric seal gaskets according to ASTM D 2321.

F. Join perforated PVC pipe and fittings according to ASTM D 2729, with loose bell-and-spigot joints.

G. Join perforated clay pipe and fittings with gaskets according to ASTM C 425.

H. Join perforated concrete pipe and fittings with gaskets according to ASTM C 443.

I. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.12 CLEANOUT INSTALLATION

A. Cleanouts for Foundation, Retaining-Wall, and Landscaping] Subdrainage:

1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
2. In vehicular-traffic areas, use NPS 4 cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 18 by 18 by 12 inches in depth. Set top of cleanout flush with grade. Cast-iron pipe may also be used for cleanouts in nonvehicular-traffic areas.
3. In nonvehicular-traffic areas, use NPS 4 PVC pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 12 by 12 by 4 inches in depth. Set top of cleanout plug 1 inch above grade.

B. Cleanouts for Underslab Subdrainage:

1. Install cleanouts and riser extensions from piping to top of slab. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
2. Use NPS 4 cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout flush with top of slab.

3.13 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect low elevations of subdrainage system to storm sewer or wetland basins solid-wall-piping storm drainage system.

C. Where required, connect low elevations of foundation subdrainage to stormwater sump pumps.

3.14 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping.

1. Install PE warning tape or detectable warning tape over ferrous piping.
2. Install detectable warning tape over nonferrous piping and over edges of underground structures.

3.15 FIELD QUALITY CONTROL

A. Testing: After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

3.16 CLEANING

A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 334600

SECTION 334605 – DRAINAGE AGGREGATE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work includes providing and installing all drainage aggregate materials to the lines and grades designated on the project construction plans.

1.2 CERTIFICATION

A. Contractor shall submit a notarized manufacturer=s certification, prior to start of work, stating that the drainage aggregate meets the requirement of this specification.

1.3 DELIVERY, STORAGE AND HANDLING

A. Plastic Pipe shall be stored in accordance with the manufacturer=s recommendations to prevent damage and deleterious materials from becoming affixed.

B. Drainage aggregate shall be stored to prevent contamination with other site and/or fill soils.

1.4 MEASUREMENT AND PAYMENT

A. Measurement of the drainage aggregate is on a cubic yard basis.

B. Payment shall cover drainage aggregate supply and installation.

C. Quantity of drainage aggregate as shown on drawings may be increased or decreased a the direction of the Engineer based on construction procedures and actual site conditions.

D. The accepted quantities of drainage aggregate will be paid for per cubic yard of net quantities shown on the construction drawings. Waste and overfill are incidental. Payment will be made under Drainage Aggregate per cubic yard.

PART 2 - MATERIALS

2.1 DEFINITIONS

A. Drainage collection pipe shall be a perforated/slotted PVC or corrugated HDPE pipe. The pipe may be covered with a knitted or non-woven geotextile sock specifically designed to function as a filter.

B. Drainage aggregate shall be a free draining material, relative to the surrounding soil, so as to prevent build up of hydrostatic pressure.

C. Drainage geotextile shall have the following minimum properties or as recommended by the Engineer.

AOS	ASTM D 4751	70-100 lb.
Grab Tensile	ASTM D 4632	110 lb.
Trap Tear	ASTM D 4533	40 lb.
Water Flow	ASTM D 4491	75 gpm/ft
Puncture	ASTM D 4833	40 lb.

2.2 PRODUCTS

A. Drainage aggregate shall be clean, 1-inch minus crushed stone or granular fill meeting the following graduation (sieve size/% passing):

1 inch/100-75%, 3/4 inch/50-75%
No. 4/0-60%, No. 40/0-50%, No. 200/0-5%

B. Drainage pipe shall be manufactured in accordance with ASTM D 3034 and/or ASTM D 1248.

C. Geotextile placed around the drainage aggregate or drain pipe shall be as outlined in Section 2.01 as recommended by the Design Engineer.

PART 3 - EXECUTION

3.1 DRAINAGE COLLECTION PIPE

A. Install the drainage collection pipe according to the line, grades and sections shown in the project construction plans.

B. Install the drainage collection pipe to maintain gravity flow of water to outside the reinforced soil zone. Daylight the drainage collection pipe at a storm sewer manhole or along a slope at an elevation lower than the lowest point of the pipe within the reinforced soil mass.

C. The main collection drain pipe just behind the segmental units shall be minimum of 3 inches in diameter. Any secondary collection drain pipe can gravity flow independently or tie into the main collection drain pipe with laterals at a maximum 50 foot spacing along the wall face.

3.2 DRAINAGE AGGREGATE

A. Install the drainage aggregate to the line, grades and section shown on the project constructions plans.

B. Place the drainage aggregate to a minimum finished thickness and widths shown on the details herein, or as directed by the Engineer.

C. When a blanket drain is installed, a non-woven geotextile should be installed prior to aggregate placement in accordance with the details provided on the drawings.

END OF SECTION 334605