LINTON - SPORTS SUPPORT FACILITY

PROJECT MANUAL VOLUME 1 –

Linton-Stockton Sports Support Facility

801 1st Street NE
Linton, Indiana

Architect Project No. 17-23

Myszak+Palmer, Inc.
903 Broadway Street
Vincennes, Indiana 47591
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329202 RESTORATION OF SURFACES

END OF INDEX TO SPECIFICATIONS
NOTICE TO BIDDERS

Notice is hereby given that the Linton-Stockton School Corporation will receive sealed bids for the listed items. Said bids will be received until 2:00PM (local time) on Thursday, February 15th at the administration office located at 801 1st Street NE, Linton, IN 47441 at which time bids will be publicly opened.

Linton-Stockton School Corporation - Sports Support Facility
801 1st Street NE, Linton IN 47441

1. Bid Package No.1- General Trades, Civil, HVAC, Electrical and Plumbing

Drawings & Specifications will be available on January 23, 2018 and may be obtained from:

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

A voluntary pre-bid meeting will be held at the administration building at 10:00 am on January 30th. All bidders are encouraged to attend.

All bids must be submitted on prescribed State Board of Accounts Bid Form 96, which includes the completed execution of a non-collusion affidavit.

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 School Corporation has made an award to the successful bidder and if satisfactory Payment and Performance Bonds have been delivered to the Linton-Stockton School Corporation.

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.

The Linton-Stockton School Corporation 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 Linton-Stockton School Corporation.

Please advertise January 22, 2018 and January 29, 2018.
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 Bid Forms and State Form 96.

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: Linton-Stockton School Sports Center

   a. Proposals shall be addressed and delivered to: 801 1st Street NE, Linton IN 47441

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 employers 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 30th 2018 at 10:00 am, 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 November 30,2018.
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 Linton-Stockton School Corporation (hereinafter called the “Owner”).

TO: Linton – Stockton School Corporation

The Bidder, in compliance with your invitation for bids for the Sports Support Facility, 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:

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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 G805) 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.

ALTERNATE BID

Alternate Bid No. 1 (ADD)

Bidder agrees to provide all labor and material to install concrete around new building, including earthwork. Area indicated on drawing sheet C5.0.

FOR THE SUM OF

______________________________ DOLLARS

($_______________________)

Alternate Bid No. 2 (ADD)

Bidder agrees to provide all labor and material to install Chain Link Fencing & Gates – match existing fencing - as indicated on drawing sheet C5.0.

FOR THE SUM OF

______________________________ DOLLARS

($_______________________)
Alternate Bid No. 3 (ADD)

Bidder agrees to provide all labor and material to install Aluminum Fencing & Gates – Ametco Falcon Design Aluminum Picket Fence, with staggered top - as indicated on drawing sheet C5.0.

FOR THE SUM OF

___________________________________________ DOLLARS

(_______________________________________)

Alternate Bid No. 4 (ADD)

Bidder agrees to provide all labor and material to install Landscaping as indicated on drawing sheet C1.0.

FOR THE SUM OF

___________________________________________ DOLLARS

(_______________________________________)

Alternate Bid No. 5 (ADD)

Bidder agrees to provide all labor and material to install North Parking Area as indicated on drawing sheet C5.0.

FOR THE SUM OF

___________________________________________ DOLLARS

(_______________________________________)

Alternate Bid No. 6 (ADD)

Bidder agrees to provide all labor and material to install Senior Parking Lot as indicated on drawing sheet C5.0.

FOR THE SUM OF

___________________________________________ DOLLARS

(_______________________________________)
Alternate Bid No. 7 (ADD)

Bidder agrees to provide all labor and material to install Elementary Staff Parking Lot as indicated on drawing sheet C5.0.

FOR THE SUM OF

__________________________

__________________________ DOLLARS

(__________________________)

Alternate Bid No. 8 (ADD)

Bidder agrees to provide all labor and material to install Tennis Softball Parking Lot as indicated on drawing sheet C5.0.

FOR THE SUM OF

__________________________

__________________________ DOLLARS

(__________________________)

Alternate Bid No. 9 (ADD)

Bidder agrees to provide all labor and material to install Sidewalk along Tennis/Softball Parking Lot as indicated on drawing sheet C5.0.

FOR THE SUM OF

__________________________

__________________________ DOLLARS

(__________________________)

Alternate Bid No. 10 (ADD)

Bidder agrees to provide all labor and material to install 6” Sanitary Sewer Pipe as indicated on drawing sheet C3.0.

FOR THE SUM OF

__________________________

__________________________ DOLLARS

(__________________________)

BF-5
Alternate Bid No. 11 (ADD)

Bidder agrees to provide all labor and material to install all Lockers as indicated on drawing sheet A1.1.

FOR THE SUM OF
___________________________________________ DOLLARS
(_______________________________)

Alternate Bid No. 12 (ADD)

Bidder agrees to provide all labor and material to install Cabinetry as indicated on drawing sheets A1.1 and A1.2

FOR THE SUM OF
___________________________________________ DOLLARS
(_______________________________)

Alternate Bid No. 13 (ADD)

Bidder agrees to provide all labor and material to install Ticket Booth as indicated on drawing sheet A1.1. Concrete slab & conduits NOT included in this Alternate Bid.

FOR THE SUM OF
___________________________________________ DOLLARS
(_______________________________)

Alternate Bid No. 14 (ADD)

Bidder agrees to provide all labor and material to install Ticket Booth as indicated on drawing sheet ST1.1 and C4.0. Concrete slab & conduits NOT included in this Alternate Bid.

FOR THE SUM OF
___________________________________________ DOLLARS
(_______________________________)
AGREEMENT

I. GENERAL

A. Description

1. The Agreement shall be the Standard Form of Agreement Between Owner and Contractor, AIA Document A101, 2017 Edition, a copy of which is on file and may be examined at the offices of the Owner and the Architect, and which when executed, will become a part of the successful bidder.
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, 1997 Edition. A copy of which is included by reference.
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.

9. **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.

10. **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.

11. **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.
BID OF

(Contractor Name)

(Address)

FOR
PUBLIC WORKS PROJECTS
OF

Filed: ________________, ______

Action taken: ________________________________

______________________________
CONTRACTOR’S BID FOR PUBLIC WORK – FORM 96

PART I

(To be completed for all bids. Please type or print)

Date: ________________________________

1. Governmental Unit (Owner): ________________________________

2. County: ________________________________

3. Bidder (Firm): ________________________________

   Address: ________________________________

   City/State: ________________________________

4. Telephone Number: ________________________________

5. Agent of Bidder (if applicable): ________________________________

   Pursuant to notices given, the undersigned offers to furnish labor and/or material necessary to complete the public works project of ________________________________

   (Governmental Unit) in accordance with plans and specifications prepared by ________________________________ and dated ________________________________ for the sum of ________________________________ $ ________________________________

The undersigned further agrees to furnish a bond or certified check with this bid for an amount specified in the notice of the letting. If alternative bids apply, the undersigned submits a proposal for each in accordance with the notice. Any addendums attached will be specifically referenced at the applicable page.

If additional units of material included in the contract are needed, the cost of units must be the same as that shown in the original contract if accepted by the governmental unit. If the bid is to be awarded on a unit basis, the itemization of the units shall be shown on a separate attachment.

The contractor and his subcontractors, if any, shall not discriminate against or intimidate any employee, or applicant for employment, to be employed in the performance of this contract, with respect to any matter directly or indirectly related to employment because of race, religion, color, sex, national origin or ancestry. Breach of this covenant may be regarded as a material breach of the contract.

CERTIFICATION OF USE OF UNITED STATES STEEL PRODUCTS

(If applicable)

I, the undersigned bidder or agent as a contractor on a public works project, understand my statutory obligation to use steel products made in the United States (I.C. 5-16-8-2). I hereby certify that I and all subcontractors employed by me for this project will use U.S. steel products on this project if awarded. I understand that violations hereunder may result in forfeiture of contractual payments.
ACCEPTANCE

The above bid is accepted this ________________ day of ________________ subject to the following conditions: ____________________________________________________________

Contracting Authority Members:

__________________________  __________________________

__________________________  __________________________

__________________________  __________________________

PART II
(For projects of $100,000 or more – IC 36-1-12-4)

Governmental Unit: __________________________________________

Bidder (Firm) __________________________________________

Date: __________________________________________

These statements to be submitted under oath by each bidder with and as a part of his bid. Attach additional pages for each section as needed.

SECTION I EXPERIENCE QUESTIONNAIRE

1. What public works projects has your organization completed for the period of one (1) year prior to the date of the current bid?

<table>
<thead>
<tr>
<th>Contract Amount</th>
<th>Class of Work</th>
<th>Completion Date</th>
<th>Name and Address of Owner</th>
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2. What public works projects are now in process of construction by your organization?

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<tr>
<th>Contract Amount</th>
<th>Class of Work</th>
<th>Expected Completion Date</th>
<th>Name and Address of Owner</th>
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3. Have you ever failed to complete any work awarded to you? ________________________________ If so, where and why?

4. List references from private firms for which you have performed work.

SECTION II PLAN AND EQUIPMENT QUESTIONNAIRE

1. Explain your plan or layout for performing proposed work. (Examples could include a narrative of when you could begin work, complete the project, number of workers, etc. and any other information which you believe would enable the governmental unit to consider your bid.)

2. Please list the names and addresses of all subcontractors (i.e. persons or firms outside your own firm who have performed part of the work) that you have used on public works projects during the past five (5) years along with a brief description of the work done by each subcontractor.

3. If you intend to sublet any portion of the work, state the name and address of each subcontractor, equipment to be used by the subcontractor, and whether you will require a bond. However, if you are unable to currently provide a listing, please understand a listing must be provided prior to contract approval. Until the completion of the proposed project, you are under a continuing obligation to immediately notify the governmental unit in the event that you subsequently determine that you will use a subcontractor on the proposed project.

4. What equipment do you have available to use for the proposed project? Any equipment to be used by subcontractors may also be required to be listed by the governmental unit.

5. Have you entered into contracts or received offers for all materials which substantiate the prices used in preparing your proposal? If not, please explain the rationale used which would corroborate the prices listed.

SECTION III CONTRACTOR’S FINANCIAL STATEMENT

Attachment of bidder’s financial statement is mandatory. Any bid submitted without said financial statement as required by statute shall thereby be rendered invalid. The financial statement provided hereunder to the governing body awarding the contract must be specific enough in detail so that said governing body can make a proper determination of the bidder’s capability for completing the project if awarded.
SECTION IV CONTRACTOR’S NON–COLLUSION AFFIDAVIT

The undersigned bidder or agent, being duly sworn on oath, says that he has not, nor has any other member, representative, or agent of the firm, company, corporation or partnership represented by him, entered into any combination, collusion or agreement with any person relative to the price to be bid by anyone at such letting nor to prevent any person from bidding nor to include anyone to refrain from bidding, and that this bid is made without reference to any other bid and without any agreement, understanding or combination with any other person in reference to such bidding.

He further says that no person or persons, firms, or corporation has, have or will receive directly or indirectly, any rebate, fee, gift, commission or thing of value on account of such sale.

SECTION V OATH AND AFFIRMATION

I HEREBY AFFIRM UNDER THE PENALTIES FOR PERJURY THAT THE FACTS AND INFORMATION CONTAINED IN THE FOREGOING BID FOR PUBLIC WORKS ARE TRUE AND CORRECT.

Dated at ____________________ this ______________ day of __________________, ___

(Name of Organization)

By ____________________________________________

(Title of Person Signing)

ACKNOWLEDGEMENT

STATE OF ________________
COUNTY OF ________________

Before me, a Notary Public, personally appeared the above-named ________________________________ and swore that the statements contained in the foregoing document are true and correct.

Subscribed and sworn to before me this ___________ day of ________________, ________.

Notary Public

My Commission Expires: _______________________

County of Residence: ________________________
List of Subcontractors

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<tr>
<th>Work/Firm Name</th>
<th>Address/Phone</th>
<th>Superintendent</th>
</tr>
</thead>
</table>

(List Subcontractors and others proposed to be employed on the above Project as required by the bidding documents.)
GEOTECHNICAL STUDY

PROJECT NAME:
NEW SPORTS SUPPORT FACILITY

PROJECT ADDRESS:
10 "H" STREET NORTHEAST
LINTON, IN 47441

PREPARED FOR:
LINTON-STOCKTON SCHOOL CORPORATION
801 1st STREET NORTHEAST
LINTON, IN 47441

PREPARED BY:
NOBLE ENGINEERING CONSULTANTS
123 EAST RAILROAD STREET FLORA, IL 62839
(618) 662-5800

JANUARY 09, 2017
Linton-Stockton School Corp.
801 1st Street NE
Linton, IN  47441

Attn: Mr. Nick Karazsia, Superintendent

RE: GEOTECHNICAL EXPLORATION REPORT
PROPOSED NEW SPORTS SUPPORT FACILITY
10 "H" STREET NORTHEAST
LINTON, IN 47441

January 9, 2017

Dear Mr. Karazsia:

We have completed the geotechnical exploration for the proposed sports support facility at 10 "H" Street NE Linton, IN. The purpose of this study was to obtain soil information from the site and provide recommendations pertinent to the design and construction of the proposed structure. This report presents the results of our field exploration, laboratory testing, foundation recommendations and construction considerations.

We appreciate the opportunity to provide professional geotechnical engineering services during this phase of your project. Please contact me with any questions.

Respectfully,

Noble Engineering Consultants

Eric E. Seals, P.E.
President
1. PROJECT DESCRIPTION

1.1 INTRODUCTION

We understand the project consists of a proposed single story concrete masonry block with approximately 7,500 sf in plan area. There are no below grade walls planned for the project.

We further understand that three separate paved areas are planned.

1.2 SCOPE OF SERVICES

1. The performance of two soil borings up to 15 feet below existing grade at the proposed building location and five soil borings up to 10 feet below existing grade at the proposed paved areas.

2. The performance of basic laboratory tests as required to classify soil.

3. Perform an engineering analysis of the subsurface conditions as related to the design and construction of the proposed structure.

4. Provide a written geotechnical report to include the following:
   - Subsurface profile presented in 8 ½” by 11” boring log format
   - Summary of field and laboratory testing results
   - Recommended building foundation type including soil properties, allowable soil bearing pressures, estimated differential and total settlement and anticipated bearing depths for foundation design. Below grade wall recommendations
   - Earthwork aspects of foundation construction
The report has been prepared under the direction of a Registered Professional Engineer in the state of Indiana in accordance with generally accepted standards and procedures in the practice of geotechnical engineering. In the event of changes in the design or location of the structure, or in the concept of the project, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the conclusions and recommendation are modified or confirmed in writing by Noble Engineering Consultants.
2. PROCEDURES

2.1 FIELD EXPLORATION

The number, location and depth of the borings for this study were determined by Myszak & Palmer in conjunction with Noble Engineering Consultants. The borings were located in the field by Noble Engineering. The field exploration was conducted by Noble Engineering Consultants on December 26, 2017. The approximate boring locations are shown on the boring location plan included as Figure 1.

The soil borings were performed with a truck mounted rotary type drill rig using 2-1/4” ID continuous flight hollow stem augers to advance the boreholes to sampling depths. Representative soil samples were obtained by means of the split barrel sampling procedures at 2½ foot intervals in the upper 10 feet and at 5 foot intervals to the boring termination, in general conformance with ASTM Standard D1586. The number of blows required to drive the sampler 12 inches with a 140 pound hammer falling 30 inches, after an initial seating of 6 inches, is termed the Standard Penetration Test (N) value. The N-values are recorded on the attached boring logs.

Image 1: View of boring B-2
Water level observations and measurements were made in the boreholes during, and at completion of the drilling operations. The water level observations are shown on the respective boring logs. The samples collected from the split barrel sampling procedures were placed in sealed bags and subsequently delivered to our laboratory for further testing and classification.

During the field operation, the drill crew maintained a log of the subsurface conditions, including changes in stratigraphy and observed groundwater level information. After completion of the drilling operations and obtaining the necessary groundwater information, the boreholes were backfilled with soil cuttings.

2.2 LABORATORY TESTING

The laboratory testing program included visual engineering classification of the recovered samples and hand penetrometer tests on representative soil samples. The soil samples were visually classified by a geotechnical engineer based upon texture and plasticity in general conformance with the Unified Soil Classification System. The results of the laboratory tests are indicated on the boring logs at the depth the samples were obtained. The boring logs are attached to this report.

In the hand penetrometer test, the unconfined compressive strength \( (Q_p) \) of a soil sample is estimated to the nearest \( \frac{1}{4} \) ton per square foot (tsf) by measuring the resistance to the soil sample to penetration by a small, calibrated, spring loaded cylinder. The maximum limit of the hand penetrometer is 4½ tons per square foot (tsf); values above this are designated 4½+ tsf.

A geotechnical engineer grouped the various soil types into major zones noted on the boring logs. For more detail regarding the soil conditions at a particular location, please refer to the individual boring logs.
3. RESULTS

3.1 SITE CONDITIONS

The property in the area of the site consists of an existing lawn and crushed rock surfaced areas for the proposed paved areas. Surface water runoff direction was not apparent but appeared to slope away from the project areas except the area of B-1 which contained ice. The areas traversed by the rig indicate the surface condition across the site is mostly firm, however the subgrade was likely frozen at the time of our exploration.

3.2 SOIL CONDITIONS

The subsurface investigation consisted of the drilling of seven test borings designated as B-1 through B-7. The surface consisted of about 4 inches of topsoil or about 0.8 to 1.4 feet of crushed rock. Stiff to very stiff silty clay was generally encountered below the surface materials except at B-2 and B-3 which contained possible fill to about 1.5 feet below existing grade and boring B-7 which encountered fill to about 4 feet below existing grade. Boring B-6 contained possible fill to about 4 feet.

The silty clay had an average N value of 11 blows per foot (bpf) and had an estimated unconfined compressive strength ranging from 1.0 to 2.1 tons per square foot (tsf).

The soils were primarily brown mottled gray and the silt clay soils are classified as CL. The soils classification is determined by the Unified Soil Classification system, a classification chart is attached to this report.
3.3 GROUNDWATER CONDITIONS

Groundwater level observations were made while drilling and at completion at each boring. Groundwater was not encountered during or at the completion of the drilling operations. Dry borehole cave occurred at the completion of drilling.

Due to the relatively short period of time the borehole remained open, the water level observations in the borehole may not be representative of the groundwater level at the site.

We estimate the long-term groundwater level is at or below our explored depth.

The prevailing hydrostatic groundwater level should be expected to fluctuate throughout the years, based on variations in precipitation, evaporation, surface run-off and other related hydrogeological factors. The groundwater levels discussed herein, and indicated on the boring log; represent the conditions at the time the measurements were obtained. Please refer to the Construction Considerations section in this report for recommendations for handling groundwater during construction.
4. ANALYSES AND RECOMMENDATIONS

Based on the soil boring information obtained during this exploration and our understanding of the proposed construction as mentioned in this report, we present the following geotechnical recommendations related to construction of the proposed structure. Our analysis has resulted in recommendations which are discussed in the following sections. If any of our assumptions or understandings are not correct, or if conditions during construction are observed to be significantly different than those encountered during the site exploration, we should be contacted immediately, so we may re-evaluate our recommendations, as necessary.

4.1 Engineered Fill Placement and Compaction

Engineered fill placed beneath the building area should be placed in lifts not exceeding 9-inches in loose thickness and be compacted to a minimum of 95 percent maximum dry density as determined in accordance with the Modified Proctor Method, ASTM D1557.

Engineered fill placed for general site grading should consist of suitable material, defined herein as an approved, environmentally clean material, free of lumps, frozen soil, wood, topsoil or other deleterious material, with a maximum particle size of 6-inches.

Based on the available soil boring information, it appears the existing near surface soils could contain fill, therefore we recommend the onsite soils not be used as engineered fill. We recommend engineered fill be imported and the onsite soils be used only in landscape areas.
We recommend the engineered fill soils be placed at moisture contents within 2 percent of the optimum moisture content as determined in accordance with Modified Proctor Method.

Fill placed for general site grading, and not under or within the influence of any structures or roads, may be onsite soils. Fill in these general site grading areas need only be compacted to the degree it is stable under construction equipment.

4.2 FOUNDATIONS

We understand shallow spread footings are planned to support the proposed structure. The soils encountered at the expected bearing elevation are classified as very stiff to stiff silty clay. We recommend a seismic site classification of “D” be used for this site. The following recommendations are given for the foundation systems.

4.2.1 Shallow Spread Footings

Spread footing type foundations are recommended for support of the proposed structure. The footings should be constructed through any fill and bear on the stiff to very stiff silty clay soils. We anticipate suitable bearing soil to be encountered at the design frost depth of 30 inches below existing grade.

We recommend an allowable soil bearing pressure of 2,900 psf be used to size the foundations bearing on stiff to very stiff silty clay. We anticipate total settlement to be less than 1” with differential settlement of about half the total settlement.
Exterior footings should extend to at least 30" below finished exterior grades for frost protection. The footing excavations should be excavated to neat lines with concrete being placed directly against cut faces. Care should be taken to excavate the foundation sidewalls vertical to reduce the likelihood of frost heave of the foundation along outward sloping foundation walls. The specifications should require concrete placement on the same day that footing excavations are made, in order to maintain the natural moisture content of the bearing soil.

4.2.3 Slab-On-Grade Construction

For the design and construction of slabs-on-grade for the proposed structures, we recommend any fill, unstable, loose, soft or organic materials revealed during stripping and proofrolling be removed. Over excavated areas must be replaced with engineered fill as discussed in section 4.1. All slab-on-grade areas should be thoroughly compacted with a compactor prior to slab construction.

After subgrade preparation has been completed, we recommend a minimum of 6 inches of free draining, granular fill material with less than 5% passing the No. 200 sieve, be placed below the slab-on-grade to act as a capillary cutoff and facilitate fine grading. A vapor barrier should also be used below the floor slab. For proper subgrade preparation we recommend a modulus of subgrade reaction (K) equal to 125 pci be used in design.

The considerations regarding proper slab finishing and curing and its effects on slab curling as discussed in ACI 302 should be reviewed and conveyed to the contractor. The slab-on-grade should be isolated from the foundation elements so as not to induce shear cracks due to settlement of the foundations.
4.3 PAVEMENTS

Fill was encountered at some of the proposed pavement boring locations. The fill materials did not appear to be deleterious however, placing any structure including paved areas on uncontrolled fill is at risk to excessive settlement. We recommend the fill encountered in these areas be removed and replaced with compacted engineered fill.

The following pavement sections are considered typical for the general area and are not based upon specific California Bearing Ratio test results or specific soil sampling. Site specific loading conditions or traffic patterns were not provided for our analysis.

Two pavement section alternatives have been provided and are labeled light duty and heavy duty. The light duty would consist of typical automobile traffic while heavy duty would consist of typical automobile traffic as well as limited heavy truck traffic such as delivery trucks, buses and waste removal trucks.

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<tr>
<th>Material</th>
<th>Light Duty Section</th>
<th>Heavy Duty Section</th>
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<tbody>
<tr>
<td>Asphalt Surface (inches)</td>
<td>1 ½</td>
<td>1½</td>
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<tr>
<td>Asphalt Binder (inches)</td>
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<td>2</td>
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<tr>
<td>Aggregate Base (inches)</td>
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<tr>
<td>Concrete (inches)</td>
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<td>7</td>
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<tr>
<td>Base for Concrete (inches)</td>
<td>6</td>
<td>6</td>
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</table>
4.4 CONSTRUCTION CONSIDERATIONS

We recommend that the site work be performed during the summer months following a warm and dry period to reduce the possibility of undercutting and replacement. We recommend all site preparation, including the work of stripping, backfilling, proofrolling, engineered fill placement and foundation excavations prior to placement of concrete on this site should be observed by a Noble representative performing an appropriate number and type of tests, to verify the work is being performed as recommended and according to the project construction documents. All soils that become loosened or softened in the subgrade or foundation excavation areas should be removed prior to placing concrete or engineered fill.

We do not anticipate groundwater will be encountered in the foundation excavations for this project. However, perched water may be encountered and we recommend the contractor be prepared to handle such limited water conditions. Surface drainage control for the proposed construction can likely be achieved through the use of localized dewatering, such as a sump and pump system. If the soils encountered at the excavation depth are wet or saturated, a layer of crushed aggregate may need to be placed to allow for a stable bottom. Engineered fill should not be placed on wet soils.

Accumulation or runoff water at the base of foundation excavations or areas receiving compacted fill should be promptly removed. Concrete should be placed shortly after foundations bearing surfaces are prepared and compacted. Exposure can cause loosening of the bearing soils.
5. GENERAL COMMENTS

This report has been prepared in accordance with generally accepted geotechnical engineering practices to aid in the evaluation of this property and to assist the engineer in the design of this project. In the event of changes in the design criteria or location of the structures, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are modified or approved in writing by our office.

The analyses and recommendations submitted in this report are based upon the data obtained from the soil borings performed within the proposed building area at the approximate locations indicated on the appended soil boring location plan. This report does not reflect variations which may occur between the borings and the actual structure locations. The nature and extent of variations may not become evident until the time of construction. If significant variations then become evident, it may be necessary for us to re-evaluate the recommendations of this report. We recommend that the contractor specifications include the following phrase.

"The contractor will, upon becoming aware of subsurface or latent physical conditions differing from those disclosed by the original soil exploration work, promptly notify the owner verbally to permit verification of the conditions, and in writing, as to the nature of the differing conditions. No claim by the contractor for any conditions differing from those anticipated in the plans and specifications and disclosed by the soil studies will be allowed unless the contractor has so notified the owner, verbally and in writing, as required above, of such differing conditions."
In the process of obtaining and testing samples and preparing this report, procedures are followed that represent reasonably accepted practice in the field of soil and foundation engineering. Specifically, field logs are prepared during the drilling and sampling operations that describe field occurrences, sampling, locations, and other information. However, the samples obtained in the field are frequently subjected to testing and reclassification in the laboratory and differences may exist between the field logs and final logs. Our recommendations are based upon the content of the final logs and the information contained herein. This report does not address any environmental concerns.

This report has been prepared for the exclusive use of Linton-Stockton School Corporation for the specific application to the proposed sports support facility construction to be located at 10 "H" Street NE Linton, IN 47441.

We trust this report will allow you to proceed with design of the proposed foundations.

Sincerely,

NOBLE ENGINEERING CONSULTANTS

Eric E. Seals, P.E.
President

Attachments:
- Boring Location Plan, Figure 1
- Site Map, Figure 2
- Boring Logs B-1 through B-7
- Soil Classification
- Legend Sheet
FIGURE I

BORING LOCATION PLAN
FIGURE II
SITE MAP
FIGURE 1
SITE: NEW SPORTS SUPPORT FACILITY
SITE LOCATION MAP
**NOBLE**

**ENGINEERING CONSULTANTS**

- Project: New Sports Support Facility
- Sheet No. 1 of 1
- 1st encounter: Dry

**Client:** Myszak & Palmer
- Weather: Overcast
- Temperature: 10's

**Driller: Noble Engineering Consultants**
- Date Start: 12-26-17
- Surface Elevation: NA
- @ completion: dry cave

**Location:** Linton, IN
- Date Finished: 12-26-17
- Backfill: soil cuttings

**BORING No. B-1**

**Temperature:** 1

**Location:** Linton, IN

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<th>Sample Depth</th>
<th>N-Value</th>
<th>Blow Count</th>
<th>Recovery (%)</th>
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**Soil Description**

- 0.0'-1.1' Crushed Rock FILL
- 1.1'-10.0' SILTY CLAY, trace gravel, stiff, brown mottled gray

**Drilling Method:** HSA (2-1/4" id)

**Comments**

- Depth: 0' to 10.0'
- Drill Rig: Mobile B-47
- Sampling: split-spoon
- Procedure: ASTM D1586
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<th>Qp (tsf)</th>
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<th>Unified Soil Class</th>
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Drilling Method: HSA (2-1/4" id)

Depth: 0' to 15.0'

Drill Rig: Mobile B-47

Sampling: split-spoon

Procedure: ASTM D1586
**NOBLE**

**ENGINEERING CONSULTANTS**

Project No.: MYZ2018A  
Sheet No. 1 of 1

**Client:** Myszak & Palmer  
**Weather:** Overcast  
**Date Start:** 12-26-17

**Driller:** Noble Engineering Consultants  
**Date Finished:** 12-26-17

**Location:** Linton, IN  
**Surface Elevation:** NA @completion: dry cave

**Project:** New Sports Support Facility

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**BORING No. B-3**

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**Drilling Method:** HSA (2-1/4' id)  
**Comments:**

**Depth:** 0' to 15.0'  
**Drill Rig:** Mobile B-47  
**Sampling:** split-spoon  
**Procedure:** ASTM D1586
**NOBLE**

**ENGINEERING CONSULTANTS**

Project No.: MYZ2018A

**BORING No. B-4**

Sheet No. 1 of 1

1st encounter: Dry

Client: Myszak & Palmer

Weather: Overcast

Temperature: 10's

Driller: Noble Engineering Consultants

Date Start: 12-26-17

Surface Elevation: NA

@completion: dry cave

Location: Linton, IN

Date Finished: 12-26-17

Driller: Tony Schocker

Backfill: soil cuttings

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Drilling Method: HSA (2-1/4" id)

Comments

Depth: 0' to 10.0'

Drill Rig: Mobile B-47

Sampling: split-spoon

Procedure: ASTM D1586
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**Drilling Method:** HSA (2-1/4” id)  
**Comments:**  
**Depth:** 0’ to 10.0’  
**Drill Rig:** Mobile B-47  
**Sampling:** split-spoon  
**Procedure:** ASTM D1586
**NOBLE ENGINEERING CONSULTANTS**  Project No.: MYZ2018A  BORING No. B-6  Sheet No. 1 of 1

Client: Myszak & Palmer  Weather: Overcast

Driller: Noble Engineering Consultants  Date Start: 12-26-17

Location: Linton, IN  Date Finished: 12-26-17

1st encounter: Dry  Temperature: 10's  Surface Elevation: NA  @ completion: dry cave

Driller: Tony Schocker  Backfill: soil cuttings

<table>
<thead>
<tr>
<th>Depth</th>
<th>Sample No.</th>
<th>Sample Depth</th>
<th>N-Value</th>
<th>Blow Count</th>
<th>Recovery (%)</th>
<th>Op (tsf)</th>
<th>Soil Description</th>
<th>Unified Soil Class.</th>
<th>Elev.</th>
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<tbody>
<tr>
<td>1</td>
<td>SS-1</td>
<td>1.0'-2.5'</td>
<td>9</td>
<td>3-4-5</td>
<td>70</td>
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<td>0.0'-0.9' Crushed Rock FILL</td>
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<td>0.9'-4.2' Silt, Clay, Etc. Possible Fill, stiff, brown</td>
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<td>4</td>
<td>SS-3</td>
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<td>4.2'-10.0' SILTY CLAY, trace gravel, stiff, brown mottled gray</td>
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Drilling Method: HSA (2-1/4" id)  Comments

Depth: 0' to 10.0'

Drill Rig: Mobile B-47

Sampling: split-spoon

Procedure: ASTM D1586
**NOBLE**

**ENGINEERING CONSULTANTS**

Client: Myszak & Palmer

Driller: Noble Engineering Consultants

Location: Linton, IN

Date Start: 12-26-17

Date Finished: 12-26-17

**BORING No. B-7**

Sheet No. 1 of 1

Client: Myszak & Palmer

Driller: Noble Engineering Consultants

Location: Linton, IN

Date Start: 12-26-17

Date Finished: 12-26-17

1st encounter: Dry

Temperature: 10's

Surface Elevation: NA

@ completion: dry cave

**Soil Description**

<table>
<thead>
<tr>
<th>Depth</th>
<th>Sample No.</th>
<th>Sample Depth</th>
<th>N-Value</th>
<th>Blow Count</th>
<th>Recovery (%)</th>
<th>Op (tsf)</th>
<th>Soil Description</th>
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<tr>
<td>1</td>
<td>SS-1</td>
<td>1.0'-2.5'</td>
<td>8</td>
<td>2-3-5</td>
<td>50</td>
<td>-</td>
<td>0.0'-0.8' Crushed Rock FILL</td>
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<td>0.8'-4.0' silt, clay, organics, masonry, FILL</td>
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Drilling: Method: HSA (2-1/4" id)

Comments

Depth: 0' to 10.0'

Drill Rig: Mobile B-47

Sampling: split-spoon

Procedure: ASTM D1586
<table>
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<tr>
<th>Major Divisions</th>
<th>Symbols</th>
<th>Typical Descriptions</th>
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<td><strong>COARSE GRAINED SOILS</strong></td>
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<tr>
<td>Gravel and gravelly soils</td>
<td>GW</td>
<td>Well-graded gravels, gravel sand mixtures, little or no fines</td>
</tr>
<tr>
<td>More than 50% of coarse fraction retained on No. 4 sieve</td>
<td>GP</td>
<td>Poorly graded gravels, gravel sand mixtures, little or no fines</td>
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<tr>
<td>Gravels with more than 12% fines</td>
<td>GM</td>
<td>Silty gravels, gravel-sand-silt mixtures</td>
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<td>Clayey gravel, gravel-sand-clay mixtures</td>
<td>GC</td>
<td>Clayey gravels, gravel-sand-clay mixtures</td>
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<tr>
<td>Clean gravels with less than 5% fines</td>
<td>SW</td>
<td>Well-graded sands, gravelly sands, little or no fines</td>
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<td>Poorly graded sands, gravelly sands, little or no fines</td>
<td>SP</td>
<td>Poorly-graded sands, gravelly sand, little or no fines</td>
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<td>Clean sands with less than 5% fines</td>
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<td>Silty-sands, sand-silt mixtures</td>
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<td><strong>FINE GRAINED SOILS</strong></td>
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<td>Silts and clays liquid limit less than 50</td>
<td>ML</td>
<td>Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity</td>
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<td>Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays</td>
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<td>Organic silts and organic silty clays of low plasticity</td>
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<td>Silts and clays liquid limit greater than 50</td>
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<td>Inorganic silts, micaceous or diatomaceous fine sand or silty soils</td>
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<td>Inorganic clays of high plasticity</td>
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<td><strong>HIGHLY ORGANIC SOILS</strong></td>
<td>PT</td>
<td>Peat, humus, swamp soils with high organic contents</td>
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<td><strong>ROCK</strong></td>
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<td>Consolidated material generally requiring special equipment to remove</td>
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<td><strong>FILL</strong></td>
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<td>Man-made fill material</td>
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<td>GRANULAR SOIL (Coarser than No. 200 sieve)</td>
<td>LEGEND FOR SOIL DESCRIPTION</td>
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<td>coarse – c</td>
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<td>No. 10 Sieve to No. 40 Sieve</td>
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<td>Less than 10% coarse and medium</td>
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<td>Less than 10% coarse</td>
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<td>Blk – black</td>
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<td>Rd – red</td>
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<tr>
<td>Gn – green</td>
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<td><strong>SAMPLE NOTATION</strong></td>
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<td>S – Split Spoon Soil Sample</td>
<td>WOC – Weight of Casing</td>
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<td>U – Undisturbed Tube Sample</td>
<td>WOR – Weight of Rods</td>
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<td>C – Core Sample</td>
<td>WOH – Weight of Hammer</td>
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<tr>
<td>B – Bulk Soil Sample</td>
<td>PPR – Compressive strength based on pocket penetrometer</td>
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<tr>
<td>NR – No Recovery of Sample</td>
<td>TV – Shear Strength (tsf) based on torvane</td>
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<td>AR - Auger Refusal</td>
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**NOTES:**

- PPR – Compressive strength based on pocket penetrometer
- TV – Shear Strength (tsf) based on torvane
Linton - Sports Support Facility

Project #17-23

January 2018

PROJECT TITLE PAGE

PROJECT MANUAL VOLUME 1 –

Linton-Stockton Sports Support Facility

801 1st Street NE
Linton, Indiana

Architect Project No. 17-23

Myszak+Palmer, Inc.
903 Broadway Street
Vincennes, Indiana 47591
Phone: 812.886.0350
Fax: 812.886.0790
Web Site: www.myszakpalmer.com
Issued: January 2018

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END OF DOCUMENT 000101
1.1 DESIGN PROFESSIONALS OF RECORD

ARCHITECT  Joshua D. Palmer
            AR10600077
            Specifications as listed
            In Project Manual

PLUMBING  Kristin Heinz
          PE11500350
          Specifications as listed
          In Project Manual

HVAC      Erik Heinz
          PE10606123
          Specifications as listed
          In Project Manual
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<td>P1.2</td>
<td>PLUMBING NOTES &amp; DETAILS</td>
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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Project information.
   2. Work covered by Contract Documents.
   3. Work by Owner (if applicable).
   4. Work under separate contracts.
   5. Owner-furnished products.
   6. Access to site.
   7. Work restrictions.
   8. Specification and drawing conventions.

B. Related Requirements:
   1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

   1. Project Location: 801 1st Street NE, Linton, IN 47441

B. Owner: Linton Stockton School Corporation; 801 1st Street NE, Linton, IN 47441

C. 1. Owner's Representative: Ralph Witty, School Board Member

D. Architect: Myszak + Palmer Inc. 903 Broadway Street, Vincennes, IN 47591, (812) 886-0350.

E. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:
1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

B. Type of Contract:
   1. Project will be constructed under one contract, Contract for General Construction.

1.5 ACCESS TO SITE

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

B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1.6 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.
   1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work to normal business working hours Monday through Friday, unless otherwise indicated.
   1. Weekend Hours: Weekend hours may be approved if schedule dictates.
   2. Early Morning Hours: No restriction

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
   1. Notify Architect not less than two days in advance of proposed utility interruptions.
   2. Obtain Architect's written permission before proceeding with utility interruptions.

D. Nonsmoking Building: Smoking is not permitted on project site or school property

E. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

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

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
   1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
   2. Abbreviations: Materials and products are identified by abbreviations
   3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000
Alternate Bid No. 1 (ADD)
Bidder agrees to provide all labor and material to install concrete around new building, including earthwork. Area indicated on drawing sheet C5.0.

Alternate Bid No. 2 (ADD)
Bidder agrees to provide all labor and material to install Chain Link Fencing & Gates – match existing fencing - as indicated on drawing sheet C5.0.

Alternate Bid No. 3 (ADD)
Bidder agrees to provide all labor and material to install Aluminum Fencing & Gates – Ametco Falcon Design Aluminum Picket Fence, with staggered top - as indicated on drawing sheet C5.0.

Alternate Bid No. 4 (ADD)
Bidder agrees to provide all labor and material to install Landscaping as indicated on drawing sheet C1.0.

Alternate Bid No. 5 (ADD)
Bidder agrees to provide all labor and material to install North Parking Area as indicated on drawing sheet C5.0.

Alternate Bid No. 6 (ADD)
Bidder agrees to provide all labor and material to install Senior Parking Lot as indicated on drawing sheet C5.0.

Alternate Bid No. 7 (ADD)
Bidder agrees to provide all labor and material to install Elementary Staff Parking Lot as indicated on drawing sheet C5.0.

Alternate Bid No. 8 (ADD)
Bidder agrees to provide all labor and material to install Tennis Softball Parking Lot as indicated on drawing sheet C5.0.
Alternate Bid No. 9 (ADD)

Bidder agrees to provide all labor and material to install Sidewalk along Tennis/Softball Parking Lot as indicated on drawing sheet C5.0.

Alternate Bid No. 10 (ADD)

Bidder agrees to provide all labor and material to install 6” Sanitary Sewer Pipe as indicated on drawing sheet C3.0.

Alternate Bid No. 11 (ADD)

Bidder agrees to provide all labor and material to install all Lockers as indicated on drawing sheet A1.1.

Alternate Bid No. 12 (ADD)

Bidder agrees to provide all labor and material to install Cabinetry as indicated on drawing sheets A1.1 and A1.2

Alternate Bid No. 13 (ADD)

Bidder agrees to provide all labor and material to install Ticket Booth as indicated on drawing sheet A1.1. Concrete slab & conduits NOT included in this Alternate Bid.

Alternate Bid No. 14 (ADD)

Bidder agrees to provide all labor and material to install Ticket Booth as indicated on drawing sheet ST1.1 and C4.0. Concrete slab & conduits NOT included in this Alternate Bid.
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.


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.

1.5 CHANGE ORDER PROCEDURES


1.6 CONSTRUCTION CHANGE DIRECTIVE


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.
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.

   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.
11. Initial progress report.
13. Certificates of insurance and insurance policies.
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."
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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900
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.

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.
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.


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 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 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

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

B. Related Requirements:
   1. Division 01 Section "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the General Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

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

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire prevention program.
1.4 QUALITY ASSURANCE
   A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
   B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

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

PART 2 - PRODUCTS

2.1 MATERIALS
   A. Portable Chain-Link Fencing: (Enclosing New Entrance/s) Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide galvanized-steel bases for supporting posts.
   B. Wood Enclosure Fence: Plywood, 6 feet high, framed with four 2-by-4-inch rails, with preservative-treated wood posts spaced not more than 8 feet apart.

2.2 TEMPORARY FACILITIES
   A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
   B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly.
   C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
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 qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
   3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Division 01 Section "Closeout Procedures."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
   1. Locate facilities to limit site disturbance as specified in Division 01 Section "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 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. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
   1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
   1. Toilets: Use of Owner's existing toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

F. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

H. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

I. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
   1. Install electric power service underground unless otherwise indicated.
   2. Connect temporary service to Owner's existing power source, as directed by Owner.

J. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
   1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

K. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
   1. Provide additional telephone lines for the following:
      a. Provide a dedicated telephone line for each facsimile machine in each field office.
   2. At each telephone, post a list of important telephone numbers.
      a. Police and fire departments.
      b. Ambulance service.
      c. Contractor's home office.
      d. Contractor's emergency after-hours telephone number.
      e. Architect's office.
      f. Engineers' offices.
      g. Owner's office.
      h. Principal subcontractors' field and home offices.
3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

3.3 SUPPORT FACILITIES INSTALLATION

A. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
   1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

B. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
   1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
   2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 31 Section "Earth Moving."
   3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
   4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 32 Section "Asphalt Paving."

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
   1. Protect existing site improvements to remain including curbs, pavement, and utilities.
   2. Maintain access for fire-fighting equipment and access to fire hydrants.

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

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
   1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
   2. Remove snow and ice as required to minimize accumulations.

F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
   1. Identification Signs: Provide Project identification signs as indicated on Drawings.
   2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
      a. Provide temporary, directional signs for construction personnel and visitors.
   3. Maintain and touchup signs so they are legible at all times.
G. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Division 01 Section "Execution."

I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
   1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.4 INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Temporary Erosion and Sedimentation Control: Comply with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Division 31 Section "Site Clearing."

D. Temporary Erosion and Sedimentation Control: 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 requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

E. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

F. Tree and Plant Protection: Comply with requirements specified in Division 01 Section "Temporary Tree and Plant Protection."

G. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

H. 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.
I. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
   1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
   2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish two sets of keys to Owner.

J. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

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

L. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

M. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
   1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

N. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and tenants from fumes and noise.
   1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
   2. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.
      a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.
   3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
   4. Insulate partitions to control noise transmission to occupied areas.
   5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
   6. Protect air-handling equipment.
   7. Provide walk-off mats at each entrance through temporary partition.

O. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire prevention program.
1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL


B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
   1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
   2. Keep interior spaces reasonably clean and protected from water damage.
   3. Discard or replace water-damaged and wet material.
   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.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
   1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
   2. Remove materials that can not be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.

2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

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.
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.

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:
   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.


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.
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 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 PERFORMANCE 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. Submittals: concrete mix designs and submittals required by ACI 301.
B. Ready-Mixed Concrete Producer Qualifications: ASTM C 94/C 94M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS


2.2 MATERIALS

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
B. Plain Steel Wire: ASTM A 82, as drawn.
C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, as drawn, flat sheet.
D. Portland Cement: ASTM C 150, Type I or II.
E. Fly Ash: ASTM C 618, Class C or F.
F. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
G. Silica Fume: ASTM C 1240, amorphous silica.
H. Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded, with at least 10 years' satisfactory service in similar applications.
   1. Maximum Coarse-Aggregate Size: 1 inch nominal.
J. Chemical Admixtures: ASTM C 494, water reducing, high-range water reducing, water reducing and accelerating, and water reducing and retarding. Do not use calcium chloride or admixtures containing calcium chloride.
K. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures.
L. Synthetic Fiber: ASTM C 1116/C 1116M, Type III, polypropylene fibers, 1/2 to 1-1/2 inches long.

M. Vapor Retarder: Reinforced sheet, ASTM E 1745, Class A.

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

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

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

1. **Products:**

   a. BASF Construction Chemicals - Building Systems; Kure-N-Seal 25 LV.

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

2.3 **CONCRETE MIXTURES**

A. Prepare design mixtures, proportioned according to ACI 301.

B. Normal-Weight Concrete:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50
3. Slump Limit: 4 inches, plus or minus 1 inch.
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.
5. Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
6. For concrete exposed to deicing chemicals, limit use of fly ash to 25 percent replacement of portland cement by weight and granulated blast-furnace slag to 40 percent of portland cement by weight; silica fume to 10 percent of portland cement by weight.

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, 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 for concrete exposed to view and Class B, 1/4 inch for other concrete surfaces.

B. Place vapor retarder on prepared subgrade, with joints lapped 6 inches 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 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 moisture curing for at least seven days.

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

K. Polished Concrete Floor Treatment: Apply polished concrete finish system to cured and prepared slabs.

1. Machine grind floor surfaces level and smooth and to depth required to reveal aggregate.
2. Apply penetrating liquid floor treatment according to manufacturer's written instructions.
3. Continue polishing with progressively finer polishing pads to gloss level required.

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

M. Protect concrete from damage. Repair and patch defective areas.

END OF SECTION 033000
SECTION 042000 - UNIT MASONRY

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. Concrete masonry units.
   2. Face brick.
   3. Mortar and grout.
   4. Steel reinforcing bars.
   5. Masonry joint reinforcement.
   6. Ties and anchors.
   7. Embedded flashing.
   8. Miscellaneous masonry accessories.
  10. Cavity-wall insulation.

B. Related Sections:
   1. Section 055000 "Metal Fabrications" for furnishing steel lintels and shelf angles for unit masonry.
   2. Section 071900 "Water Repellents" for water repellents applied to unit masonry.
   3. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
   1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

1. Clay Masonry Unit Test: For each type of unit required, according to ASTM C 67 for compressive strength.
2. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
3. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
4. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
5. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.
6. Prism Test: For each type of construction required, according to ASTM C 1314.

1.6 ACTION SUBMITTALS

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

B. Shop Drawings: For the following:
1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:
1. Glazed Tile, full size sample
2. Split Face Block
3. Colored mortar
4. Weep holes

D. Samples for Verification: For each type and color of the following:
1. Glazed Block, full size sample
2. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.
3. Weep holes
4. Accessories embedded in masonry.
1.7 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
   1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Qualification Data: For testing agency.

C. Material Certificates: For each type and size of the following:
   1. Masonry units.
      a. Include material test reports substantiating compliance with requirements.
      b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
      c. For exposed brick, include test report for efflorescence according to ASTM C 67.
      d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
   2. Cementitious materials. Include brand, type, and name of manufacturer.
   3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
   4. Grout mixes. Include description of type and proportions of ingredients.
   5. Reinforcing bars.
   7. Anchors, ties, and metal accessories.

D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
   2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.
1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

E. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
   1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high by full thickness.
   2. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
   3. Clean exposed faces of panels with masonry cleaner indicated.
   4. Protect approved sample panels from the elements with weather-resistant membrane.
   5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
      a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls and hold cover securely in place.
   2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
   1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
   2. Provide bullnose units for outside corners unless otherwise indicated.

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

C.

D. CMUs: ASTM C 90.
   1. Density Classification: Normal Weight.
   2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
   3. Bullnose outside corners.

E. Split-Face Concrete Masonry Units: ASTM C 90; Weight Classification, Normal Weight.
   1. Finish: Exposed faces with split-face finish.
   2. Available Products:
      a. Jones and Sons Split face block
      b. Color: Concrete Gray

2.3 MASONRY LINTELS

A. General: Provide one of the following:

B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure
2.4 GLAZED FACE BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

B. Glazed Face Brick:
   1. Manufacturer: Elgin Butler
      a. Color: #8800 Classic Red; #2200A Cobalt
      b. Size: 6Y 12- SQUARE 11 5/8 H x 11- 5/8 L x 3 5/8 W

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

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

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91.
   1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Essroc, Italcementi Group;
      b. Match Existing Masonry Cement Color – Submit to Architect for Approval.

E. Mortar Cement: ASTM C 1329.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Lafarge North America Inc.; Lafarge Mortar Cement or Magnolia Superbond Mortar Cement.

F. Aggregate for Mortar: ASTM C 144.
   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
   2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
   3. White-Mortar Aggregates: Natural white sand or crushed white stone.
   4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for structural-clay tile facing units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.

I. Refractory Mortar Mix: Ground fireclay or non-water-soluble, calcium aluminate, medium-duty refractory mortar that passes ASTM C 199 test; or an equivalent product acceptable to authorities having jurisdiction.

J. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Euclid Chemical Company (The); Accelguard 80.
      c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.

K. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
   1. Interior Walls: Hot-dip galvanized, carbon steel.
   2. Exterior Walls: Hot-dip galvanized, carbon steel.
   3. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
   4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
   5. Wire Size for Veneer Ties: 0.148-inch (3.77-mm) diameter.
   6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
   7. Provide in lengths of not less than 10 feet (3 m).

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.7 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

B. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Products:
   a. Pos-I-Tie #75-TC (Thermal Clip) Brick Veneer Anchoring system with 3/16” diameter double pintle wire. Hot dip galvanized. Determine length so as to meet ACI 530 requirements. Embed masonry screw at end of barrel system 2” into CMU backup with adjustable pintle wire anchor no closer than 5/8” from exterior face of brick.

C. Partition Top anchors: 0.105-inch- (2.66-mm-) thick metal plate with 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

2.8 MISCELLANEOUS ANCHORS

A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.

B. Anchor Bolts: Headed 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; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

C. Postinstalled Anchors: Torque-controlled expansion anchors.
   1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
   2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 unless otherwise indicated.

2.9 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual", Section 076200 "Sheet Metal Flashing and Trim" and as follows:
   1. Aluminum

B. Flexible Flashing: Use the following unless otherwise indicated:
   1. Vinyl Flashing

C. Application: Unless otherwise indicated, use the following:
   1. Where flashing is indicated to receive counterflashign, use metal flashing.
   2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
   3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
4. Where flashing is fully concealed, use flexible flashing.

D. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from high-density polyethylene incorporating chemical stabilizers that prevent UV degradation. Cell flashing pans have integral weep spouts that are designed to be built into mortar bed joints and weep collected moisture to the exterior of CMU walls and that extend into the cell to prevent clogging with mortar.

1. **Products:** Subject to compliance with requirements, provide the following:
   a. Mortar Net USA, Ltd.; Blok-Flash.

E. Solder and Sealants for Sheet Metal Flashings:

1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
2. Solder for Copper: ASTM B 32, Grade Sn50; 50 percent tin and 50 percent lead.
3. Elastomeric Sealant: ASTM C 920, chemically curing urethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Use the following unless otherwise indicated:

1. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch (9-mm) OD by 4 inches (100 mm) long.
   a. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) Hohmann & Barnard, Inc.; #341

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. **Products:** Subject to compliance with requirements, provide the following:
   a. Mortar Net USA, Ltd.; Mortar Net.
2. Provide the following configuration:
   a. Strips, full-depth of cavity and 10 inches (250 mm) high, with dovetail shaped notches 7 inches (175 mm) deep that prevent clogging with mortar droppings.

F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
   1. **Products:** Subject to compliance with requirements, provide one of the following:
      a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
      c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
      d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.11 MASONRY-CELL INSULATION

A. Loose-Granular Fill Insulation: Perlite complying with ASTM C 549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).

2.12 CAVITY-WALL INSULATION

A. “Cavitymate Ultra” by ‘Dow’ Extruded Polystyrene Foam Insulation. 1 ¾” Thick.

2.13 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
   1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
      a. Diedrich Technologies, Inc.
      b. EaCo Chem, Inc.
      c. ProSoCo, Inc., Sure Klean #600

2.14 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-enthraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.
B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry:
   1. For masonry below grade or in contact with earth, use Type S.
   2. For reinforced masonry, use Type S.
   3. 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.
   4. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Grout for Unit Masonry: Comply with ASTM C 476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
   2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
   3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

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

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.
C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

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

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

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:
   1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
   2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
   3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:
   1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
   3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
   4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
   5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
   6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:
1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed CMU Masonry: Unless otherwise indicated, lay exposed cmu masonry in stack bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches (100-mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
   1. Install compressible filler in joint between top of partition and underside of structure above.
   2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.
   3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
   4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow brick as follows:
   1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
   2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
   3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
   4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 COMPOSITE MASONRY

A. Bond wythes of composite masonry together using one of the following methods:
   1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. (0.25 sq. m) of wall area spaced not to exceed 24 inches (610 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (914 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.
      a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.
   a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
   b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.

3. Header Bonding: Provide masonry unit headers extending not less than 3 inches (76 mm) into each wythe. Space headers not over 8 inches (203 mm) clear horizontally and 16 inches (406 mm) clear vertically.

B. Bond wythes of composite masonry together using bonding system indicated on Drawings.

C. Collar Joints: Solidly fill collar joints by parging face of first wythe that is laid and shoving units of other wythe into place.

D. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.
   1. Provide continuity with masonry joint reinforcement at corners by using prefabricated L-shaped units as well as masonry bonding.

E. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:
   1. Provide individual metal ties not more than 16 inches (406 mm) o.c.
   2. Provide continuity with masonry joint reinforcement by using prefabricated T-shaped units.
   3. Provide rigid metal anchors not more than 24 inches (610 mm) o.c. If used with hollow masonry units, embed ends in mortar-filled cores.

3.7 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:
      a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
      b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.
      c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.
   2. Header Bonding: Provide masonry unit headers extending not less than 3 inches (76 mm) into each wythe. Space headers not over 8 inches (203 mm) clear horizontally and 16 inches (406 mm) clear vertically.

B. Bond wythes of cavity walls together using bonding system indicated on Drawings.
C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

D. Parge cavity face of backup wythe in a single coat approximately 3/8 inch (10 mm) thick. Trowel face of parge coat smooth.

E. Coat cavity face of backup wythe to comply with Section 071113 "Bituminous Dampproofing."

F. Apply air barrier to face of backup wythe to comply with Section 072726 "Fluid-Applied Membrane Air Barriers."

G. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches (300 mm) o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
   1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.8 MASONRY-CELL INSULATION

A. Pour granular insulation into cavities to fill void spaces. Maintain inspection ports to show presence of insulation at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of insulation to 1 story high, but not more than 20 feet (6 m).

3.9 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
   1. Space reinforcement not more than 16 inches (406 mm) o.c.
   2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.
3.10 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
   1. Provide an open space not less than 1 inch (25 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
   2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
   3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.11 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:
   1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
   2. Install preformed control-joint gaskets designed to fit standard sash block.
   3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
   4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick as follows:
   1. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch (10 mm) for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

D. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch (10 mm).
   1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.12 LINTELS

A. Provide concrete or masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.
3.13  FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

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

B. Install flashing as follows unless otherwise indicated:
1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 4 inches (100 mm), and through inner wythe to within 1/2 inch (13 mm) of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches (50 mm) on interior face.
3. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches (200 mm); with upper edge tucked under building paper or building wrap, lapping at least 4 inches (100 mm).
4. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
5. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
6. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
7. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.
8. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
9. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
E. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
1. Use specified weep/vent products to form weep holes.
2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.
4. Space weep holes formed from plastic tubing or wicking material 16 inches (400 mm) o.c.
5. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
6. Trim wicking material flush with outside face of wall after mortar has set.

F. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches (50 mm), to maintain drainage.
1. Fill cavities full height by placing pea gravel in cavities as masonry is laid so that at any point masonry does not extend more than 24 inches (600 mm) above top of pea gravel.

G. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

H. Install vents in head joints in exterior wythes.
1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.14 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).
3.15 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Level 1 special inspections according to the "International Building Code."
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.

E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.

F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

H. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

I. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

J. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.16 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
C. **In-Progress Cleaning:** Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. **Final Cleaning:** After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
   7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
   8. Clean stone trim to comply with stone supplier's written instructions.
   9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

### 3.17 MASONRY WASTE DISPOSAL

A. **Salvageable Materials:** Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. **Waste Disposal as Fill Material:** Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
   2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
   3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

C. **Excess Masonry Waste:** Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

**END OF SECTION 042000**
SECTION 042300 - GLASS UNIT MASONRY

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Samples for selecting glass-block.

PART 2 - PRODUCTS

2.1 GLASS BLOCK

A. Hollow Glass Block: Units made from transparent glass, with manufacturer's standard edge coating.

1. Manufacturers:
   [One of the following:]
2. Basis of Design Product: Pittsburgh corning, standard premiere series or a comparable product of one of the following:
   a. Mulia Inc. (Distributed by Glass Blocks Unlimited and Mulia, Inc.).
   b. Nippon Electric Glass Co., Ltd. (Distributed by Glass Blocks Unlimited and Nippon Electric Glass America, Inc.).
   c. Oberland Glas AG, Bauglas Div.; Solaris Glasstein (Distributed by Glass Blocks Unlimited and North America Glass).
   d. Pittsburgh Corning Corporation.
   e. Seves (Distributed by Glass Blocks Unlimited, International Product Supply, and Seves North America).
   f. J. Weck GmbH (Distributed by Glashaus, Inc. and Glass Blocks Unlimited).

3. Glass Color: Colorless
4. Pattern: Decora
5. Edge-Coating Color: White
6. Unit Sizes: Manufacturer's standard sizes corresponding to nominal sizes indicated on Drawings.
7. Unit Thickness: 8"x8"

2.2 GLASS-BLOCK GRID SYSTEMS

A. Sealant: Product recommended by glass-block grid system manufacturer.

2.3 GLASS UNIT MASONRY ACCESSORIES

A. Asphalt Emulsion: ASTM D 1187 or ASTM D 1227.
B. Expansion Strip: Polyethylene-foam type complying with requirements of glass-block manufacturer.

C. Sealants: Comply with Section 079200 "Joint Sealants."

2.4 MORTAR
A. Mortar for Glass Unit Masonry: ASTM C 270, Type S.
   1. Use portland cement-lime mortar.

PART 3 - EXECUTION

3.1 INSTALLING GLASS BLOCK WITH MORTAR
A. Apply a heavy coat of asphalt emulsion to sill and adhere expansion strips to jambs and heads with asphalt emulsion. Allow asphalt emulsion to dry before placing mortar.
B. Completely fill bed and head joints.
C. Rake out and point joints with sealant at exterior face of exterior panels

END OF SECTION 042300
SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS
   A. Submittals: Shop Drawings.

PART 2 - PRODUCTS

2.1 METALS
   A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
   B. Nonshrink, Nonmetallic Grout: ASTM C 1107; recommended by manufacturer for exterior applications.

2.2 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. Fabricate loose lintels from steel angles and shapes. Size to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches (200 mm).
   C. Fabricate pipe bollards from Schedule 80 steel pipe.

2.3 STEEL AND IRON FINISHES
   A. Hot-dip galvanize steel fabrications at exterior locations.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Provide anchorage devices and fasteners where needed to secure items to in-place construction.
   B. Perform cutting, drilling, and fitting required for installing miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack.
C. Fit exposed connections accurately together to form hairline joints or, where indicated, with uniform reveals and spaces for sealants and joint fillers.

D. Anchor bollards in concrete and fill solidly with concrete, mounding top surface.

END OF SECTION 055000
SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Model code evaluation reports for wood-preservative treated wood fire-retardant treated wood engineered wood products and metal framing anchors.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: Provide dressed lumber, S4S, marked with grade stamp of inspection agency.

B. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

2.2 TREATED MATERIALS

A. Preservative-Treated Materials: AWPA C2, except that lumber not in ground contact and not exposed to the weather may be treated according to AWPA C31 with inorganic boron (SBX).

1. Use treatment containing no arsenic or chromium.
2. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
3. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

B. Provide preservative-treated materials for items indicated on Drawings, and the following:

1. Wood members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Concealed members in contact with masonry or concrete.
3. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 LUMBER

A. Dimension Lumber:

1. Maximum Moisture Content: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness.
2. Non-Load-Bearing Interior Partitions: Construction or No. 2: Mixed southern pine: SPIB.

3. Framing Other Than Non-Load-Bearing Partitions: Construction or No. 2: Southern pine: SPIB.

B. Exposed Boards: Mixed southern pine, No. 1: SPIB; with 15 percent maximum moisture content.

C. Concealed Boards: Mixed southern pine, No. 2: SPIB; with 15 percent maximum moisture content.

D. Miscellaneous Lumber: Construction, or No. 2 grade with 15 percent maximum moisture content of any species. Provide for nailers, blocking, and similar members.

2.4 ENGINEERED WOOD PRODUCTS

A. Engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be demonstrated by comprehensive testing.

B. Laminated-Veneer Lumber: Manufactured with exterior-type adhesive complying with ASTM D 2559. Allowable design values determined according to ASTM D 5456.

1. Extreme Fiber Stress in Bending, Edgewise: 2600 psi for 12-inch nominal-depth members.
2. Modulus of Elasticity, Edgewise: 1,800,000 psi.

2.5 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: Plywood, Exposure 1, C-D Plugged, fire-retardant treated, not less than 1/2 inch thick.

2.6 MISCELLANEOUS PRODUCTS

A. Fasteners: Size and type indicated. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

2. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

B. Metal Framing Anchors: Structural capacity, type, and size indicated.
1. Use anchors made from hot-dip galvanized steel complying with ASTM A 653/A 653M, G60 coating designation for interior locations where stainless steel is not indicated.

2. Use anchors made from stainless steel complying with ASTM A 666, Type 304 for exterior locations and where indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Securely attach rough carpentry to substrates, complying with the following:

1. CABO NER-272 for power-driven fasteners.
2. Published requirements of metal framing anchor manufacturer.

END OF SECTION 061000
SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Model code evaluation reports for preservative-treated plywood, foam-plastic sheathing and building wrap.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS, GENERAL

A. Plywood: DOC PS 1.

B. Oriented Strand Board: DOC PS 2.

2.2 WALL SHEATHING

A. Oriented-Strand-Board Wall Sheathing: Exposure 1, Structural I sheathing.

B. Gypsum Wall Sheathing:


2. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

2.3 ROOF SHEATHING

A. Oriented-Strand-Board Roof Sheathing: Exposure 1, Structural I sheathing.

2.4 MISCELLANEOUS PRODUCTS

A. Fasteners: Size and type indicated.

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.


B. Weather-Resistant Sheathing Paper:

C. Sheathing Joint-and-Penetration Treatment Materials:
   1. Sealant for Gypsum Sheathing Board: Joint sealant recommended by sheathing manufacturer for application indicated.
   2. Sheathing Tape for Gypsum Sheathing Board: Self-adhering glass-fiber tape recommended by sheathing and tape manufacturers for application indicated.

D. Adhesives for Field Gluing Panels to Framing: APA AFG-01.

E. Flexible Flashing: Adhesive rubberized-asphalt compound, bonded to polyethylene film, with an overall thickness of 0.030 inch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Securely attach to substrates, complying with the following:
   1. CABO NER-272 for power-driven fasteners.

B. Sheathing Joint-And-Penetration Treatment: Seal sheathing joints according to sheathing manufacturer's written instructions.

C. Building Wrap Installation:
   1. Seal seams, edges, fasteners, and penetrations with tape.
   2. Extend into jambs of openings and seal corners with tape.

END OF SECTION 061000
SECTION 061753 - SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads indicated without exceeding TPI 1 deflection limits.

B. Submittals: Product Data, Shop Drawings, and structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

D. Comply with applicable requirements and recommendations of the following publications:

1. TPI 1, "National Design Standard for Metal Plate Connected Wood Truss Construction."
2. TPI DSB, "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses."
3. TPI HIB, "Commentary and Recommendations for Handling, Installing & Bracing Metal Plate Connected Wood Trusses."

E. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review, any species, graded visually or mechanically.

1. Provide dry lumber with 19 percent maximum moisture content at time of dressing.

B. Connector Plates: TPI 1, fabricated from hot-dip galvanized steel sheet complying with 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); G60 coating designation; and not less than 0.036 inch thick.
C. Fasteners: Where trusses are exposed to weather or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.


2.2 FABRICATION

A. Assemble trusses using jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted. Fabricate wood trusses within manufacturing tolerances in TPI 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and brace trusses according to TPI recommendations and as indicated. Install trusses plumb, square, and true to line and securely fasten to supporting construction.

B. Anchor trusses securely at bearing points; use metal framing anchors. Install fasteners through each fastener hole in metal framing anchor.

C. Securely connect each truss ply required for forming built-up girder trusses. Anchor trusses to girder trusses.

D. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.

1. Install bracing to comply with Division 06 Section "Rough Carpentry."
2. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.

E. Install wood trusses within installation tolerances in TPI 1.

F. Do not cut or remove truss members.

G. Remove wood trusses that are damaged or do not meet requirements and replace with trusses that do meet requirements.

END OF SECTION 061753
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
4. HLF Furniture Inc., Belleville, Michigan

CASEWORK 064100 - 3
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 CL20 cabinet liner. Use to balance face laminate.


10. Color of Laminate

   a. Exposed Exterior: As selected by Architect from full complement of choices, to match existing.
   b. Exposed Interior: To match exterior (Exposed Interiors include open cabinets)
   c. Semi-Exposed: As selected by Architect from standard colors, to match existing
   d. Concealed Exterior: As selected by Architect from standard colors, to match existing

B. Melamine

1. Melamine shall be saturated paper laminated to core. Weight of paper shall not be less than 80 grams.


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 ⅛ 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.


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. Wilsonart - Gibraltar
   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 depth 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 scribeable, 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 - EXECUTION

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 SECTION REQUIREMENTS

A. Submittals: Product Data.

B. Surface-Burning Characteristics: ASTM E 84, and as follows:
   1. Flame-Spread Index: 25 or less where exposed; otherwise, as indicated in Part 2 "Insulation Products" Article.
   2. Smoked-Developed Index: 450 or less.

PART 2 - PRODUCTS

2.1 INSULATION PRODUCTS

A. Mineral-Fiber-Blanket Insulation: ASTM C 665, Type I, unfaced Type III, Class A, foil faced on 1 side with fibers manufactured from glass, with flame-spread index of 25 or less. Equivalent to Certainteed, Johns Mansville or Owens-Corning.

2.2 ACCESSORIES

A. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed to fit between roof framing members and to provide cross-ventilation between attic spaces and vented eaves.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install insulation in areas and in thicknesses indicated or required to produce R-values indicated. Cut and fit tightly around obstructions and fill voids with insulation.

B. Except for loose-fill insulation and insulation that is friction fitted in stud cavities, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

C. Place loose-fill insulation to comply with ASTM C 1015.
SECTION 074113 - METAL ROOF PANELS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Summary: Factory-formed metal roof panels, soffit, fascia, and trim.

B. Submittals: Product Data and color Samples.

C. Warranties: Provide manufacturer's standard written warranty, without monetary limitation, signed by manufacturer agreeing to promptly repair or replace metal roof panels that fail to remain weathertight within 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL ROOF PANELS

A. Wind-Uplift Resistance of Roof Assemblies: UL 580, Class A.

B. Roof Panel Type: Standing seam metal roof panels.

1. Basis of Design Product:
   a. MBCI; Div. of NCI Building Systems. LOKSEAM, 16” panel width, 24 ga., striated finish, Signature 300 Coating. Color to be Brite Red.

C. Soffit:

1. Basis of Design Product:
   a. MBCI; Div. of NCI Building Systems. Artisan, 12” panel width, 24 ga., Signature 300 Coating. Color to be Brite Red. Concealed fasten panel.
   b. Install solid panel for main product installation throughout except where ventilated. Install ventilated panels at a maximum of 48”o.c. throughout the installation, spaced so no area of soffit is unventilated.

2.2 ACCESSORIES

A. Provide components required for a complete roof panel assembly including trim, fasciae, clips, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
B. Flashing and Trim: Formed from 0.025-inch nominal thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet. Provide flashing and trim as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal roof panels.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Apply self-adhering sheet underlayment at eaves and rakes from edges of roof to at least 36 inches inside exterior wall line.

B. Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

1. Steel Roof Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized-steel fasteners for surfaces exposed to the interior.
2. Provide metal closures at rake edges, rake walls, and each side of ridge caps.
3. Flash and seal metal roof panels with weather closures at eaves, rakes, and perimeter of all openings.
4. Install ridge caps as metal roof panel work proceeds.

C. Install gaskets, joint fillers, and sealants where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants recommended by metal roof panel manufacturer.

END OF SECTION 074113
SECTION 074600 - SIDING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data, Samples, and ICC-ES evaluation reports.

B. Warranties: Manufacturer's standard from in which siding manufacturer agrees to repair or replace siding that fails in materials or workmanship within 5/50 years. Failures include, but are not limited to, cracking, deforming, fading or otherwise deteriorating beyond normal weathering.

PART 2 - PRODUCTS

2.1 SIDING

A. Engineered Wood Siding Factory primed.

1. Manufacturers: LP Smart Side Siding

2. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186.

3. Horizontal Pattern: Lap, Boards 6-inches (159 to 165 mm)

4. Basis-of-Design Product:

   a. Louisiana-Pacific Corporation.

5. Horizontal Pattern: 6-inch (165- or 178-mm) exposure in plain board style. Pre-Finished, color to be selected from samples provided.

2.2 SOFFIT

A. Aluminum Soffit: AAMA 1402.

1. Manufacturers:

2. Basis-of-Design Product:

   a. Alcoa Home Exteriors, Inc.
   b. Gentek Building Products, Inc.
   c. Kaycan Ltd.
   d. Norandex/Reynolds Distribution; an Owens Corning company.
   e. Rollex Corporation.
3. Pattern: V-grooved, 6-inch (152-mm) exposure, 10-inch (254-mm) exposure in double 5-inch (127-mm) style.
5. Finish: Three-coat PVDF

2.3 ACCESSORIES

A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
   1. Provide accessories matching color and texture of adjacent siding unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Engineered wood siding and aluminum soffit per manufacturer's recommendations. aluminum siding and soffit and related accessories according to AAMA 1402.
   1. Install fasteners no more than 24 inches (600 mm) o.c.

END OF SECTION 074600
SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data, Shop Drawings, and color Samples.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper as recommended by manufacturer for use intended and finish indicated.

B. Aluminum Finish: High-performance organic; AA-C12C42R1x; two-coat fluoropolymer system complying with AAMA 2604, with finish coats containing at least 70 percent polyvinylidene fluoride resin by weight

2.2 ROOF SPECIALTIES

A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Gutters, Downspouts, Fascia:

1. Available Products:
   a. Reynolds Aluminum, Red

2. Gutters: Manufactured formed gutter, with mitered and welded or soldered corner units, end caps, outlet tubes, and other accessories. Elevate back edge at least 1 inch (25 mm) above front gutter rim. Furnish with flat-stock gutter straps and gutter support brackets and expansion joints and expansion-joint covers fabricated from same metal as gutters. Fabricate from exposed metal indicated below.
   a. Gutter Style: 6" Ogee (K-Style)
   b. Aluminum: 0.040 inch (1.0 mm)

3. Downspouts: Rectangular closed-face with mitered elbows, manufactured from the following exposed metal. Furnish wall brackets of same material and finish as downspouts, with anchors.
a. Formed Aluminum: 0.040 inch (1.0 mm) thick.

b. 3” x 4”, plain square profile, unless noted otherwise.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate with installation of roof decks and other substrates to produce a watertight assembly capable of withstanding inward and outward loading pressures, and thermal and lateral loads.

B. Expansion Provisions: Install running lengths to allow controlled expansion for movement of metal components, and to prevent water leakage, deformation, or damage.

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 SECTION REQUIREMENTS

A. Submittals: Product Data and color Samples.

B. Environmental Limitations: Do not proceed with installation of joint sealants when ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F (4.4 deg C).

PART 2 - PRODUCTS

2.1 JOINT SEALANTS

A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under service and application conditions.

B. Sealant for Use in Building Expansion Joints:

1. Single-component, neutral-curing silicone sealant, ASTM C 920, Type S; Grade NS; Class 25; Uses T, M, and O, with the additional capability to withstand 100 percent movement in extension and 50 percent movement in compression for a total of 150 percent movement.

C. Sealant for General Exterior Use Where Another Type Is Not Specified, One of the Following:

1. Single-component, nonsag urethane sealant, ASTM C 920, Type S; Grade NS; Class 25; and Uses NT, M, A, and O.

D. Sealant for Exterior Traffic-Bearing Joints, Where Slope Precludes Use of Pourable Sealant:

1. Single-component, nonsag urethane sealant, ASTM C 920, Type S; Grade NS; Class 25; Uses T, NT, M, G, A, and O.

E. Sealant for Exterior Traffic-Bearing Joints, Where Slope Allows Use of Pourable Sealant:

1. Single-component, pourable urethane sealant, ASTM C 920, Type S; Grade P; Class 25; Uses T, M, G, A, and O.

F. Sealant for Use in Interior Joints in Ceramic Tile and Other Hard Surfaces in Kitchens and Toilet Rooms and Around Plumbing Fixtures:
1. Single-component, mildew-resistant silicone sealant, ASTM C 920, Type S; Grade NS; Class 25; Uses NT, G, A, and O; formulated with fungicide.

G. Sealant for Interior Use at Perimeters of Door and Window Frames:

1. Latex sealant, single-component, nonsag, mildew-resistant, paintable, acrylic-emulsion sealant complying with ASTM C 834.

2.2 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer.

B. Cylindrical Sealant Backings: ASTM C 1330, of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with ASTM C 1193.

B. Comply with ASTM C 919 for use of joint sealants in acoustical applications.

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, Republic 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.
SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing per the following:

1. Vertical Access Doors: NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Manufacturers: One of the following:

B. Basis-of-Design Product: JL Industries SMT-12-12 Access Panels for ceilings and Cendrex RMD 24-24 for CMU Chase Wall Access or a comparable product of one of the following:

1. Access Panel Solutions.
2. Acudor Products, Inc.
3. Alfab, Inc.
4. Babcock-Davis.
5. Cendrex Inc.
7. Jensen Industries; Div. of Broan-Nutone, LLC.
10. Larsen’s Manufacturing Company.
11. Maxam Metal Products Limited.
12. Metropolitan Door Industries Corp.
13. MIFAB, Inc.
14. Milcor Inc.
15. Nystrom, Inc.

C. Flush Access Doors with Exposed Flanges: Prime-painted steel units. Finish paint
D. Recessed Access Doors with hidden flange: Prime-painted steel, finish paint.
E. Locks: Flush to finished surface, key operated ceiling, cam lock walls.
F. Size: As shown above.

2.3 MATERIALS
A. Steel Sheets: ASTM A 1008/A 1008M or ASTM A 591/A 591M.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install access doors and panels accurately in position. Adjust hardware and door and panels for proper operation.
B. Install fire-rated access doors and panels according to NFPA 80.

END OF SECTION 083113
SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS
   A. Submittals: Product Data and Shop Drawings.

PART 2 - PRODUCTS

2.1 OVERHEAD COILING DOORS
   A. Manufacturers: One of the following:
      1. C.H.I. Rolling Steel Doors – Service Doors, Series 6000
      2. Cornell Iron Works, Inc.- Thermiser Insulated Doors
      3. Overhead Door Corporation – Rolling Service,625 Series, Insulated
      4. Wayne-Dalton Corp. – Coiling doors, 800-C Insulated

   B. Structural Performance, Exterior Doors: Provide doors capable of withstanding 20 lbf/sq. ft. (960 Pa) wind-loading pressure.

   C. Door Curtain Slats: Galvanized steel 20 ga. min. exterior, flat-profile, insulated slats.

   D. Finish: Polyester powder coated, color to be selected by Architect.

   E. Operation: Electrical.

   F. Obstruction Detection Device: Equip motorized door with external automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.

   G. Tracks, Supports, and Hardware: Manufacturer's standard.

   H. Weatherseals: Provide replaceable weather stripping at bottom and at top of exterior doors.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install door, track, and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports.
B. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

C. Test and adjust controls and safeties.

END OF SECTION 083323
SECTION 083325 - COILING COUNTER DOORS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and Shop Drawings.

PART 2 - PRODUCTS

2.1 OVERHEAD COILING DOORS

A. Manufacturers: One of the following:

1. C.H.I. Rolling Steel Doors. – Service Doors, Series 6000
2. Cornell Iron Works, Inc.- Thermiser Insulated Doors
3. Overhead Door Corporation. – Rolling Service,625 Series, Insulated
4. Wayne-Dalton Corp. – Coiling doors, 800-C Insulated

B. Structural Performance, Exterior Doors: Provide doors capable of withstanding 20 lbf/sq. ft. (960 Pa) wind-loading pressure.

C. Door Curtain Slats: Galvanized steel 20 ga. min. exterior, flat-profile, insulated slats.

D. Finish: Polyester powder coated, color to be selected by Architect.

E. Operation: chain operated

F. Tracks, Supports, and Hardware: Manufacturer's standard.

G. Weatherseals: Provide replaceable weather stripping at bottom and at top of exterior doors.

H. Locking Device: Cylinder. Key to building Master Key system per Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install door, track, and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports.
B. Accessibility: Install overhead coiling doors, and controls along accessible routes in compliance with regulatory requirements for accessibility.

C. Test and adjust controls and safeties.

END OF SECTION 083323
1.1 Refer to "General and Special Conditions", and "Instructions to Bidders", Division 1 of Specifications. Requirements of these Sections and the project drawings shall govern work in this section.

1.2 Summary:

A. Section Includes:

1. Furnish all items of Finish Hardware specified, scheduled, shown or required herein except those items specifically excluded from this section of the specification.

B. Related work:

1. Division 1 – General Requirements
2. Division 6 – Rough Carpentry
3. Division 6 – Finish Carpentry: Installation of Finish Hardware
4. Division 8 – Steel Doors and Frames
5. Division 8 – Wood Doors
6. Division 8 – Aluminum Framed Entrances and Storefronts
7. Division 10 – Operable Partitions
8. Division 28 – Security Access Systems

C. Specific Omissions: Hardware for the following is specified or indicated elsewhere, unless specifically listed in the hardware sets:

1. Cabinet Hardware
2. Signs
3. Chain link and wire mesh doors and gates
4. Access doors and panels
5. Overhead and Coiling doors

1.3 Submittals:

A. Hardware Schedule

1. Submit number of Hardware Schedules as directed in Division 1.
2. Follow guidelines established in Door & Hardware Institute Handbook (DHI) Sequence and Format for the Hardware Schedule unless noted otherwise.
3. Schedule will include the following:
   a. Door Index including opening numbers and the assigned Finish Hardware set.
   b. Preface sheet listing category only and manufacturer's names of items being furnished as follows:
<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>SPECIFIED</th>
<th>SCHEDULED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges</td>
<td>Manufacturer A</td>
<td>Manufacturer B</td>
</tr>
<tr>
<td>Lock sets</td>
<td>Manufacturer X</td>
<td>Manufacturer X</td>
</tr>
<tr>
<td>Kick Plates</td>
<td>Open</td>
<td>Manufacturer Z</td>
</tr>
</tbody>
</table>

c. Hardware Locations: Refer to Article 3.1.B.2 Locations.
d. Opening Description: Single or pair, number, room locations, hand, active leaf, degree of swing, size, door material, frame material, and UL listing.
e. Hardware Description: Quantity, category, product number, fasteners, and finish.
f. Headings that refer to the specified Hardware Set Numbers.
g. Scheduling Sequence shown in Hardware Sets.
h. Product data of each hardware item, and shop drawings where required, for special conditions and specialty hardware.
i. Electrified Hardware system operation description.
j. "Vertical" scheduling format only. "Horizontal" schedules will be returned "Not Approved."
k. Typed Copy.
l. Double-Spacing.
m. 8-1/2 x 11 inch sheets
n. U.S. Standard Finish symbols or BHMA Finish symbols.

B. Product Data:
1. Submit, in booklet form Manufacturers Catalog cut sheets of scheduled hardware.
2. Submit product data with hardware schedule.

C. Wiring Diagrams:
1. Submit elevation drawings showing relationship of all electrical and pneumatic hardware components to door and frame. Indicate number and gage of wires required.
   a. Include wiring drawing showing point to point wire hook up for all components.
   b. Include system operations descriptions for each type of opening; describe each possible condition.

D. Key Schedule:
1. Submit detailed schedule indicating clearly how the Owner's final keying instructions have been followed.
2. Submit as a separate schedule.

E. Samples:
1. Prior to submittal of the final hardware schedule and prior to final ordering of finish hardware, submit one sample, if required, of each type of exposed hardware unit, finished as required and tagged with full description for coordination with schedule.
2. Samples will be returned to the supplier. Units, which are acceptable and remain undamaged through submittal, review and field comparison procedures, may, after final check of operation, be used in the work, within limitations of keying coordination requirements.

F. Operations and Maintenance Manuals
1. Provide operations and maintenance manuals for each type of door hardware.

1.4 Quality Assurance
A. Requirements of Regulatory Agencies:
1. Furnish finish hardware to comply with the requirements of laws, codes, ordinances, and regulations of the governmental authorities having jurisdiction where such requirements exceed the requirements of the Specifications.
2. Furnish finish hardware to comply with the requirements of the regulations for public building accommodations for physically handicapped persons of the governmental authority having jurisdiction and to comply with Americans with Disabilities Act.
3. Provide hardware for fire rated openings in compliance with NFPA 80 and state and local building code requirements. Provide only hardware that has been tested and listed by UL for types and sizes of doors required and complies with requirements of door and door frame labels.

B. Supplier:
1. Mechanical Hardware
   a. Shall be an established firm dealing in contract builders’ hardware. He must have adequate inventory, qualified personnel on staff and be located within 100 miles of the project. The distributor must be a factory-authorized dealer for all materials required. The supplier shall be or have in employment an Architectural Hardware Consultant (AHC).
2. Electrified Hardware:
   a. Shall be an experienced door hardware supplier who has completed projects with electrified door hardware similar in material, design, and extent to that indicated for this project, whose work has resulted in construction with a record of successful in-service performance, and who is acceptable to manufacturer of primary materials.
   b. Shall prepare data for electrified door hardware, including shop drawings, based on testing and engineering analysis of manufacturer’s standard units in assemblies similar to those indicated for this project.
   c. Shall have experience in providing consulting services for electrified door hardware installations.

C. Installer:
1. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing
door hardware similar in quantity, type, and quality to that indicated for this Project.

D. Pre-installation Meeting:
   1. Before hardware installation, General Contractor/Construction Manager will request a hardware installation meeting be conducted on the installation of hardware; specifically that of locksets, closers, exit devices, overhead stops and coordinators. Manufacturer's representatives of the above products, in conjunction with the hardware supplier for the project, shall conduct the meeting. Meeting to be held at job site and attended by installers of hardware for aluminum, hollow metal and wood doors. Meeting to address proper coordination and installation of hardware, per finish hardware schedule for this specific project, by using installation manuals, hardware schedule, templates, physical product samples and installation videos.
   
   2. When any electrical or pneumatic hardware is specified this meeting shall also include the following trades/installers: Electrical, Security, Alarm systems and Architect.
   
   3. Convene one week or more prior to commencing work of this Section.
   
   4. The Hardware Supplier shall include the cost of this meeting in his proposal.

E. Manufacturer:
   1. Obtain each type of hardware (latch and locksets, hinges, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.
   
   2. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Fire-Rated Door Assemblies:
   1. Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
   
   2. Positive Pressure Test: After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches (1000 mm) or less above the sill.

1.5 Product Delivery, Storage, and Handling:

A. Inventory door hardware on receipt.

B. Label each item of hardware with the appropriate door number and Hardware Schedule heading number, and deliver to the installer so designated by the contractor.

C. Provide secure lock-up for door hardware delivered to Project site.

1.6 Warranties:

A. Refer to Division 1 for warranty requirements.
B. During the warranty period, replace defective work, including labor, materials and other costs incidental to the work. Replace work found to be defective as defined in the General Conditions.

1.7 Maintenance and Service:

A. Furnish a complete set of specialized tools for the Owner’s continued adjustment, maintenance, and removal/replacement of door hardware.

PART 2 - PRODUCT

2.1 Manufacturers:

A. Furnish each category with the products of only one manufacturer unless specified otherwise; this requirement is mandatory whether various manufacturers are listed or not.

B. Provide the products of manufacturer designated or if more than one manufacturer is listed, the comparable product of one of the other manufacturers listed. Where only one manufacturer or product is listed, it is understood that this is the owner’s Building Standard and “no substitution” is allowed.

C. The first manufacture listed for each product is the manufacture used in the hardware sets.

2.2 Materials:

A. Screws and Fasteners:

1. Furnish fasteners of the proper type, size, quantity and finish. Use machine screws and expansion shields for attaching hardware to concrete or masonry, and wall grip inserts at hollow wall construction. Furnish machine screws for attachment to reinforced hollow metal doors and frames and reinforced aluminum doors and frames. Furnish full thread wood screws for attachment to solid wood doors and frames. "TEK" type screws are not acceptable.

2. Sex bolts will not be permitted on reinforced metal doors or wood doors where blocking is specified.

B. Hinges:

1. Quantity: Provide the following, unless otherwise indicated:
   a. Two Hinges: For doors with heights up to 60 inches (1524 mm).
   b. Three Hinges: For doors with heights 61 to 90 inches (1549 to 2286 mm).
   c. Four Hinges: For doors with heights 91 to 120 inches (2311 to 3048 mm).
   d. For doors with heights more than 120 inches (3048 mm), provide 4 hinges, plus 1 hinge for every 30 inches (750 mm) of door height greater than 120 inches (3048 mm).
2. **Hinge Sizes:** Provide the following, unless otherwise indicated:
   a. **4-1/2 inches high:** For all doors with widths of 36 inches or less.
   b. **5 inches high:** For all doors with widths greater than 36 inches.

3. **Hinge Base Metal Thickness:** Provide the following, unless otherwise indicated:
   a. **Medium Weight Doors with Medium Frequency:** 0.134 inches thick.
   b. **Heavy Weight Doors with High Frequency:** 0.180 inches thick.

4. **Hinge Base Metal:** Unless otherwise indicated, provide the following:
   a. **Exterior Hinges:** Stainless steel, with stainless-steel pin.
   b. **Interior Hinges:** Steel, with steel pin.
   c. **Hinges for Fire-Rated Assemblies:** Steel, with steel pin.

5. **Hinge Options:** Where indicated in door hardware sets or on Drawings:
   a. **Nonremovable Pins:** Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for out-swinging exterior doors and out-swinging corridor doors with locks.
   b. **Corners:** Square.
   c. **Width of Hinges:** Shall be sufficient to clear all trim.

6. **Fasteners:** Provide Phillips flat-head screws comply with the following:
   a. **Machine Screws:** For metal doors and frames. Install into drilled and tapped holes.
   b. **Wood Screws:** For wood doors and frames.
   c. **Threaded-to-the-Head Wood Screws:** For fire-rated wood doors.
   d. **Finish screw heads to match surface of hinges.**

7. **Manufacturers:**
   a. **Ives; an Allegion Company 5BB1 series (IVE).**
   b. **Bommer Industries, Inc., BB5000 series (BOM).**
   c. **Hager Companies, BB series (HAG).**

C. **Continuous Gear Hinge:**
   1. **General:** 6063-T6 aluminum alloy, anodized finish (cap on entire hinge painted if specified). Manufacture to template, uncut hinges non-handed, pinless assembly, three interlocking extrusions, full height of door and frame, lubricated polyacetal thrust bearing, fasteners 410 stainless steel plated and hardened. All hinge profiles to be manufactured to template bearing locations, with standard duty bearing configurations at 5-1/8" spacing with a minimum of 16 bearings: and heavy duty at 2-9/16" spacing with a minimum of 32 bearings. Anodizing of material shall be done after fabrication of components so that all bearing slots are anodized.
   2. **Length:** 1" less than door opening height. Fastener 12-24 x 1/2" #3 Phillips keen form stainless steel self-tapping at aluminum and hollow metal doors, 12-1/2" #3 Philips, flathead full thread at wood doors.
   3. **Furnish fire rated hinges "FR" at labeled openings.**
   4. **Manufacturers:**
      a. **For Aluminum frames;**
         1) **Manufacturers:**
            a) **Ives; an Allegion Company, 112HD series (IVE).**
            b) **Select Products Ltd., SL11HD series (SEL).**
            c) **Pemko, FMSLFHD series (PEM).**

D. **Locks and Latches:**
1. Mortise Locks:
   a. All Mortise Locks shall be designed to meet BHMA A156.13, Grade 1 test standards and certified by an independent testing laboratory.
   b. Locksets shall be manufactured from heavy gauge steel, minimum lockcase thickness 1/8", containing components of steel with a zinc dichromate plating for corrosion resistance.
   c. Locks are to have a standard 2 ¾" backset with a full ¾" throw two-piece stainless steel mechanical anti-friction latchbolt. Deadbolt shall be a full 1" throw, constructed of stainless steel.
   d. Lockcase shall be easily handed without chassis disassembly by removing handing screw on lockcase and installing in opposite location on reverse side. Changing of door hand bevel from standard to reverse hand shall be done by removing the lockcase scalp plate, and pulling and rotating the latchbolt 180 degrees.
   e. Lock trim shall be through-bolted to the door to assure correct alignment and proper operation. Lever trim shall have external spring cage mechanism to assist in support of the lever weight.
   f. Provide strikes with extended lips where required to protect trim from being marred by latch bolt. Provide strike lips that do not project more than 1/8" beyond door frame trim at single doors and have 7/8" lip to center at pairs of 1-3/4" doors.
   g. Verify lock functions with architect/owner prior to ordering.
   h. Manufacturers:
      1) Best; a Stanley Black and Decker Company, 45H series (BES). NO SUBSTITUTION

i. Lockset Trim:
   1) Best, 15J

E. Exit Devices:

1. Touchpad Style:
   a. Exit devices shall be touchpad style, fabricated of brass, bronze, stainless steel, or aluminum, plated to the standard architectural finishes to match the balance of the door hardware.
   b. All exit devices shall incorporate a fluid damper, which decelerates the touchpad on its return stroke and eliminates noise associated with exit device operation. Touchpad shall extend a minimum of one half of the door width. All latchbolts to be deadlatching type, with a self-lubricating coating to reduce wear.
   c. End-cap will be sloped to deflect any impact from carts and they shall be flush with the external mechanism case. End caps that overlap and project above the mechanism case are unacceptable. End cap shall utilize a two-point attachment to the mounting bracket.
   d. Touchpad shall match exit device finish, and shall be stainless steel for US26, US26D, US28, US32, and US32D finishes. Only compression springs will be used in devices, latches, and outside trims or controls.
   e. Plastic templates shall be included with each exit device to facilitate a quick, easy and accurate installation.
   f. Strikes shall be roller type and come complete with a locking plate to prevent movement.
g. All rim and vertical rod exit devices shall have passed a 5 million (5,000,000) cycle test based on ANSI A156.3, 1994, Grade 1 test standards and certified by an independent testing lab.

h. All mortise exit devices shall have passed a 10 million (10,000,000) cycle test based on ANSI A156.3, 1994, Grade 1 test standards and certified by an independent testing lab.

i. Provide cylinder dogging on panic exit hardware where noted in hardware sets.

j. Exit devices shall be UL listed panic exit hardware. All exit devices for fire rated openings shall be UL labeled fire exit hardware.

k. Lever trim for exit devices shall be vandal-resistant type, which will travel to a 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.

l. Manufacturers:
   1) Von Duprin; an Allegion Company, 99/33A series (VON). NO SUBSTITUTION

m. Trim:
   1) As specified in sets.
   2) Levers to match lockset design where specified.

F. Surface Door Closers:

1. All Surface Door Closers shall be designed to meet BHMA A156.4, Grade 1 test standards and certified by an independent testing laboratory.

2. Door closers shall have fully hydraulic, full rack and pinion action with a high strength cast iron cylinder. Cylinder body shall be 1 ½” in diameter, and double heat treated pinion shall be 11/16” in diameter with double D slab drive arm connection.

3. Hydraulic fluid shall be of a type requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to –30 degrees F.

4. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for the physically handicapped. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed, and backcheck.

5. All closers shall have solid forged steel main arms (and forged forearms for parallel arm closers).

6. All surface mounted mechanical closers shall be certified to exceed ten million (10,000,000) full load cycles by a recognized independent testing laboratory.

7. Closers will have Powder coating finish certified to exceed 100 hours salt spray testing by ETL, an independent testing laboratory used by BHMA for ANSI certification.

8. Refer to door and frame details and furnish accessories such as drop plates, panel adapters, spacers and supports as required to correctly install door closers. State degree of door swing in the hardware schedule.

9. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.

10. Manufacturers:
    a. LCN; an Allegion Company, 4040XP series (LCN). NO SUBSTITUTION

G. Automatic Operators
1. Low Energy ADA Special Closers (Electric)
   a. Where “Low Energy Power Operated Door” as defined by ANSI Standard A156.19 is indicated for doors required to be accessible to the disabled, provide electrically powered operators complying with the ADA requirements for opening force and time to close standards.
   b. Full closing force shall be provided when the power or assist cycle ends.
   c. Modular design, adjustments easily accessible from the front, UL listed for use on labeled doors.
   d. Shall have “Second Chance” function to accommodate momentary resistance, “Breakaway” function in the electronically controlled clutch, “Soft Start” motor control function and “Maintain Hold-Open Switch” to hold the door open at 90 degree.
   e. Shall have built in 12V and 24V power supply for actuators, card readers, electric strikes and magnetic door locks, inputs for both swing and stop side sensors and available to accept either 120VAC or 220VAC input power. All wiring connections between operator modules made by easy-to-handle electrical connectors. Shall comply with both UL and NEC requirements for Class 1 and Class 2 wiring by providing separate conduits for each.
   f. Shall have seven independent electronic adjustments to tailor the operator for specific site conditions. Opening speed, holding force at 90 deg., sequential trigger and time delay, hold-open time at 90 deg., opening force, clutch “breakaway” force setting, electric strike trigger and time delay.
   g. Shall have separate and independent adjustments for back check, main speed and latch speed.
   h. Furnish actuators and other controls as shown in Hardware Sets.
   i. Manufacturers:
      1) LCN; an Allegion Company, 4600 series (LCN). NO SUBSTITUTION

H. Door Trim:

   1. Push Plates: 4 x 16 x .050 inches.
   2. Pull, Offset: One inch round rod, 90 degree offset, 10” centers.
   3. Pulls: One inch round rod, straight 10” centers.
   4. Pull Plates: 4 x 16 x .050 inches. 10” center.
   5. Manufacturers:
      a. Ives; an Allegion Company, series as listed in sets (IVE).
      b. Equal products from any member of B.H.M.A.

I. Protection Plates:

   1. Kick Plates:
      a. Furnish beveled on 4 edges, countersink fasteners, .050” thick x 10” high x 1-1/2” less door width for the push side on single doors and 1” less door width for the push side on pairs. Adjust width on pairs accordingly for other conflicting hardware (astragals, mullions, etc).
   2. Mop Plates:
      a. Furnish beveled on 4 edges, countersink fasteners, .050” thick x 4” high x 1” less door width for the pull side.
3. Manufacturers:
   a. Ives; an Allegion Company, 8400 series and 8402 series for rated openings for plates over 16" high (IVE).

J. Door Stops:

1. Wall Bumpers:
   a. Wrought, approximately 2-1/2 inch diameter, convex or concave rubber center (as noted in sets), concealed fasteners.
      2) Equal products of any B.H.M.A. manufacturer.

2. Overhead Stops and Holders:
   a. Size per manufacturer's selector chart. Plastic end caps, hold open mechanisms and shock blocks are not allowed. End caps must be finished same as balance of unit.
   c. Manufacturers:
      1) Glynn-Johnson; an Allegion Company, series as listed in sets (GLY).
      2) Architectural Builders Hardware (ABH).

K. Thresholds and Gasketing:

1. Thresholds, 1/2" high saddle:
   a. Furnish full wall opening width when frames are recessed.
   b. Cope at jambbs and in front of mullions if thresholds project beyond door faces.
   c. Furnish with non-ferrous Stainless Steel Screws and Lead Anchors.
   d. Provide slip resistant coating at exterior openings or openings where moisture is present.
   e. Provide with thermal break at exterior doors.
   f. Equal to Zero 625.

2. Door Sweeps:
   a. Surface applied Neoprene.
   b. Provide with drip cap at exterior doors.
   c. Equal to Zero 8198.

3. Perimeter Gasketing:
   a. Apply to head and jamb stops.
   b. Solid Bar stock all sides.
   c. Mount perimeter gasketing prior to other hardware.
   d. As equal to Zero 429.

4. Mullion Seals:
   a. Applied to removeable mullions at exterior doors.
   b. As equal to Zero 8780N.

5. Manufacturers:
   a. Zero (ZER).
   b. National Guard Products.
   c. Reese.
L. Electrified Hardware

1. Power Transfers:
   a. Transfer power from door frame to edge of door, UL listed R4504.
   b. Power transfer to be concealed when door is closed.
   c. Manufacturers:
      1) Von Duprin; an Allegion Company, EPT series (VON). NO SUBSTITUTION

2. Power Supplies:
   a. Universal 120-240 VAC input, low voltage DC regulated and filtered, fused primary input, NEMA 1 enclosure, high voltage protective cover, 12/24 VDC output field selectable with jumper, single polarized connector for distribution board.
   b. Provide amperes greater than that of loads.
   c. Manufacturers:
      1) Von Duprin; an Allegion Company, PS series (VON). NO SUBSTITUTION

3. Door Position Switches:
   a. Coordinate voltage requirements with Electrical Drawings and Specifications.
   b. Manufacturers:
      1) Schlage Corporate Electronics; an Allegion Company, 679-05 (SCE). NO SUBSTITUTION

M. Miscellaneous Hardware:

1. Lock Protector:
   a. Lock protector shall eliminate gap between door and frame. No exposed fasteners on face of unit.
      1) Ives; an Allegion Company, LG10 (IVE).
      2) Equal products of any BHMA manufacturer.

2. Silencers:
   a. Provide silencers for all interior doors without gasketing.
      1) Ives; an Allegion Company, SR series (IVE).
      2) Equal product of any BHMA manufacturer

3. Drip Caps
   a. Size drip cap: Door width plus 4”
      1) Zero, 142A (NGP).
      2) Equal by NGP or Reese

N. Furnish items not categorized in the above descriptions but specified by manufacturer’s names in Hardware Sets.

2.3 Finishes:

A. Generally, Dull Chrome, US26D / BHMA 626. Provide finish for each item as indicated in sets.

2.4 Cylinders and Keying:
A. All cylinders for this project will be supplied by one supplier regardless of door type and location.

B. The Finish Hardware supplier will meet with Architect and/or Owner to finalize keying requirements and obtain keying instructions in writing.

C. Provide a cylinder for all hardware components capable of being locked.

D. Provide cylinders master and grand master keyed to Owner’s existing system. Verify existing System with Owner.

E. Provide cylinders with construction cores or keying for use during the construction period. When so directed, and in the presence of the Owner’s security department or representative, convert construction cores or keying to the final system.

F. When performing changeover from construction key system to final key system deliver to the Architect or Owner’s Representative the following cut keys:
   1. 25 each Temporary construction Operating keys.
   2. 2 each Temporary construction Control Keys.
   3. 2 each Control Keys.
   4. 2 each Great Grand/Grand Master Keys.
   5. 4 each Master/Sub Master keys per group.
   6. 2 each Keys per cylinder.

2.5 Key Control:

A. Key Cabinet
   1. Provide a key control system including envelopes, labels, tags with self-locking key clips, receipt forms, 3 way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150 percent of the number of locks required for the project.
   2. Provide complete cross-index system set up by hardware supplier or Lockset Manufacturers’ representative or Lockset Manufacturers authorized Service Center. Place keys on markers and hooks in the cabinet as determined by the final key schedule. Provide hinged panel type cabinet for wall mounting. Provide one each wall mounted key cabinet. Provide loan record system.
   3. Manufacturers:
      a. Telkee

2.6 Templates and Hardware Location:

A. Furnish hardware made to template. Supply required templates and hardware locations to the door and frame manufacturers.

B. Furnish metal template to frame/door supplier for continuous hinge.

PART 3 - EXECUTION
3.1 Installation

A. General:

1. Install hardware according to manufacturer’s installations and template dimensions. Attach all items of finish hardware to doors, frames, walls, etc. with fasteners furnished and required by the manufacture of the item.

2. Provide blocking/reinforcement for all wall mounted Hardware.

3. Reinforced hollow metal doors and frames and reinforced aluminum door and frames will be drilled and tapped for machine screws.


5. Continuous gear hinges attached to hollow metal doors and frames and aluminum doors and frames: 12-24 x 1/2" #3 Phillips Keenform self-tapping. Use #13 or 3/16 drill for pilot.

6. Continuous Gear Hinges require continuous mortar guards of foam or cardboard 1/2" thick x frame height, applied with construction adhesive.

7. Install weather-strip gasket prior to parallel arm closer bracket, rim exit device or any stop mounted hardware. Gasket to provide a continuous seal around perimeter of door opening. Allow for gasket when installing finish hardware. Door closers will require special templating. Exit devices will require adjustment in backset.

B. Locations:

1. Dimensions are from finish floor to center line of items.

2. Include this list in Hardware Schedule.

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges</td>
<td>Door Manufacturer's Standard</td>
</tr>
<tr>
<td>Levers</td>
<td>Door Manufacturer's Standard</td>
</tr>
<tr>
<td>Exit Device Touchbar</td>
<td>Per Template or center on door midrail</td>
</tr>
<tr>
<td></td>
<td>(verify)</td>
</tr>
<tr>
<td>Pulls (BTB)</td>
<td>42&quot;</td>
</tr>
<tr>
<td>Pulls</td>
<td>42&quot;</td>
</tr>
<tr>
<td>Push Plates</td>
<td>45&quot;: avoid conflict with Deadbolt</td>
</tr>
<tr>
<td>Pull Plates</td>
<td>42&quot;: avoid conflict with Deadbolt</td>
</tr>
<tr>
<td>Wall Bumpers</td>
<td>Suitable for Lock Lever, Exit Trim, or Pull</td>
</tr>
<tr>
<td>Lock Protectors</td>
<td>Pull side of door</td>
</tr>
</tbody>
</table>

C. Installation of Access Control Components:

1. Electrical Contractor shall be responsible for supplying and installing high voltage wiring to the access control panels, automatic door operators and to all doors requiring 110V to the low voltage power supplies. Includes mounting power supply boxes to the walls, supplied through door hardware sets and terminating high voltage to the power supplies. Terminations of the low voltage electrified door hardware shall be the responsibility of access control contractor including
push buttons for automatic operators. Conduit for access control, automatic operators and all electrified door hardware by electrical contractor.

2. Access Control Supplier/Contractor shall be responsible for supplying and installing all low voltage wiring necessary to complete the installation of wall mounted card readers, reader interfaces, etc. and electrified door hardware/accessories. Low voltage wire terminations of the access control panel, electrified door hardware, and power supplies shall be the responsibility of access control supplier/contractor.

D. Final Adjustment:

1. The general contractor shall provide the services of a representative to inspect material furnished and its installation and adjustment, and to instruct the Owner's personnel in adjustment, care and maintenance of hardware.
2. Locksets, closers and exit devices shall be inspected by the factory representative to insure correct installation and proper adjustment in operation. The manufacturer's representative shall prepare a written report stating compliance, and also recording locations and kinds of non-compliance. The original report shall be forwarded to the Architect with copies to the Contractor, hardware supplier, hardware installer and building owner.

3.2 Hardware Sets:

**Hardware Set #1 (Exterior, Panic)**
- Continuous Hinges
- Panic Device
- Surface Closer
- Stop
- Threshold
- Weatherstripping
- Bottoms
- Kickplate

**Hardware Set #2 (Exterior, Standard Use)**
- Hinges Lockset
- Surface Closer
- Wall Stop
- Threshold
- Weatherstripping
- Bottoms
- Kickplate (Restrooms)
Hardware Set #3 (Exterior, Privacy)
Hinges
Lockset (Privacy function)
Surface Closer
Wall Stop
Threshold
Weatherstripping
Bottoms
Kickplate

Hardware Set #4 (Interior, General)
Hinges
Lockset
Wall Stop

Hardware Set #5 (Interior, Privacy)
Hinges
Lockset (Privacy)
Wall Stop

Hardware Set #6 (Interior w/ Closer)
Hinges
Lockset
Surface Closer
Wall Stop

Hardware Set #7 (Coiling Doors)
Cylinder
END OF SECTION
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.

C. STC-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 90 and classified per ASTM E 413 by a qualified independent testing and inspecting agency.

PART 2 - PRODUCTS

2.1 PANEL PRODUCTS

A. Provide in maximum lengths available to minimize end-to-end butt joints.

B. Interior Gypsum Board: ASTM C 36/C 36M or ASTM C 1396/C 1396M, in thickness indicated, with manufacturer's standard edges. Type X throughout. Sag-resistant type for ceiling surfaces.

C. Water-Resistant Gypsum Backing Board: ASTM C 630/C 630M or ASTM C 1396/C 1396M, in thickness indicated. Type X. At all Wet locations.

2.2 ACCESSORIES

A. Trim Accessories: ASTM C 1047, formed from galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet. For exterior trim, use accessories formed from hot-dip galvanized-steel sheet, plastic, or rolled zinc.

1. Provide cornerbead at outside corners unless otherwise indicated.
2. Provide LC-bead (J-bead) at exposed panel edges.
3. Provide control joints max. 30’ o.c.

B. Joint-Treatment Materials: ASTM C 475/C 475M.

1. Joint Tape: Paper unless otherwise recommended by panel manufacturer.
2. Joint Compounds: Drying-type, ready-mixed, all-purpose compounds. Use setting-type compounds at exterior soffits.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install gypsum board to comply with ASTM C 840.
   1. Isolate gypsum board assemblies from abutting structural and masonry work. Provide edge trim and acoustical sealant.
   3. Multilayer Fastening Methods: Fasten base layers and face layer separately to supports with screws.

B. Fire-Resistance-Rated Assemblies: Comply with requirements of listed assemblies.

   1. At concealed areas, unless a higher level of finish is required for fire-resistance-rated assemblies, provide Level 1 finish: Embed tape at joints.
   2. At substrates for tile, provide Level 2 finish: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges.
   3. 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.

END OF SECTION 092900
SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and Samples.

B. Extra Materials: Deliver to Owner at least 10 linear feet, of each type and color of resilient wall base installed.

PART 2 - PRODUCTS

2.1 WALL BASE

A. Available Manufacturers:
   1. Johnsonite
   2. Roppe
   3. Flexco

B. Color and Pattern: As selected by architect/owner

C. ASTM F 1861, Type TV (vinyl) Type TP (rubber, thermoplastic).


E. Style: Cove (with top-set toe).

F. Minimum Thickness: 0.125 inch.

G. Height: 4 inches.

H. Lengths: coils in manufacturer's standard lengths.

I. Outside Corners: premolded.

J. Inside Corners: premolded.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement- or blended hydraulic cement-based formulation provided or approved by flooring manufacturer for applications indicated.
B. Adhesives: Water-resistant type recommended by manufacturer to suit products and substrate conditions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare concrete substrates according to ASTM F 710. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

B. Adhesively install resilient wall base and accessories.

C. Install wall base in maximum lengths possible. Apply to walls, columns, pilasters, casework, and other permanent fixtures in rooms or areas where base is required.

D. Install reducer strips at edges of floor coverings that would otherwise be exposed.

END OF SECTION 096513
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 carpet tile installed, packaged with protective covering for storage.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Products:

1. J+J Flooring Group – Invision, Alter Ego Modular (24” x 24”), Style 7070, Color-1839 Classified

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with CRI 104.

B. Installation Method: As recommended by manufacturer.

END OF SECTION 096813
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.

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

B. CONCRETE MASONRY UNITS – SHOWER ROOMS (epoxy coating):
* Use on all exposed surfaces within Shower Rooms.
1st Coat - Epoxy Filler/ Sealer
"S-W, Kem Cati-Coat HS Epoxy Filler/ Sealer, Part A B42W400 and Part B B42V401"

2nd Coat - Fast Cure Epoxy

3rd Coat - Fast Cure Epoxy

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
SECTION 09984- DECORATIVE EPOXY FLAKE FLOOR COATING

PART 1- GENERAL

1.01 WORK INCLUDED

A. Resinous flooring: Abrasion, impact and chemical resistant, decorative aggregate-filled epoxy-resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.

B. Extent of decorative mosaic floor coatings are indicated on Drawings and specified here in.

1.02 QUALITY ASSURANCE

A. Installer: A firm familiar with work with not less than five years of experience in installing products similar to those required for this project.

B. Deliver materials to project site in original packages or containers clearly labeled to identify manufacturer, brand name, quality or grade and fire hazard classification.

C. Store materials in original undamaged packages or containers. Maintain temperature in storage area above 40°F. Store per manufacturer's recommendations.

D. Illuminate areas of installation using building's permanent lighting system; temporary lighting alone will not be acceptable.

1.03 SUBMITTALS

A. Material Samples:
   1. If selection is not specified, provide full entire range of samples for Architect’s selection
   2. Provide sample to match that as specified, including colors, decorative flakes incorporated, texture, slip-resistant additive, and all coats of system complete.

B. Manufacturer’s Literature:
   1. Manufacturer’s literature, installation instructions, and maintenance data.
   2. Materials Safety and Data Sheets.

PART 2 - PRODUCTS

2.01 MATERIAL

A. Basis of Specification:
   1. “Sherwin-Williams/General Polymers”; Decorative Epoxy Flake Floor Coating System.
B. Fast Cure Epoxy Floor Coating/Decorative Flake Additive/Slip-Resistant Additive/Urethane Top Coat:
   1. 1st Coat: "Sherwin-Williams/ General Polymers", “3579”, epoxy primer
       Rate of Application:
       200-300 SF/ gallon.

   2. 2nd Coat: "Sherwin-Williams/ General Polymers", “3745” body coat.
       Rate of Application:
       200-300 SF/ gallon.
       * Apply decorative broadcast paint flake over second coat while still tacky and not completely cured.
       * Blastrac pattern shall be completely hidden by second coat. Additional coats as required by Architect to achieve desired and intended result to hide below.

       Rate of Application:
       160-250 SF/ gallon.

       Rate of Application:
       250-400 SF/ gallon.

C. Integral Cove Base:
   1. Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer’s written instructions and details including those for taping, mixing, priming, troweling, sanding and topcoating of cove base. Round internal and external corners.
   2. 8” high or as noted on Drawings.

D. Color:
   1. Coating and decorative flake colors as selected by Owner from manufacturer’s entire selection.

E. Finish:
   1. Gloss finish.
   2. Withstand heavy industrial traffic, abrasion, and general chemical attack.

F. Additives, Primers and Sealers:
   1. None permitted.
   2. Concrete Kure-N-Seal product not permitted in areas to receive concrete floor coating.
   3. The use of Quick-Kick Epoxy Accelerator is not permitted in areas to receive concrete floor coating.

G. Slip-Resistant Additive:
1. "Sherwin-Williams"; “General Polymers 5240 (220 Mesh) White Aluminum Oxide”.
2. Small granular particles for addition to finish coats and topcoats during the mixing process and applied with the coating material, encapsulated by the resin system.
3. Results in increased slip resistance, skid-inhibiting surface profile, granulized surface texturing, and gloss reduction.
4. Rate of mixture and application is to be in strict accordance with the manufacturer's published instructions and recommendations.

PART 3 - EXECUTION

3.01 PREPARATION

A. Ensure floor surfaces are clean, dry, sound, and fully cured. Remove all form release agents, curing compounds, salts, efflorescence, laitance, oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion.

B. Consult manufacturer's recommendation for substrate prep and cleaning.

C. Test floor for vapor drive in accordance with ASTM D 4263 and manufacturer's recommendations.

D. Blastrac entire floor surface to receive specified floor coatings. Required finished profile of CSP1-3 prior to any coating taking place.

E. Repair concrete imperfections, apply crack fillers, and install joint sealants as required and as compatible with floor coating products.

F. Clean all surfaces of oil, grease, or other bond-inhibiting materials per manufacturer's recommendations.

G. Surfaces must be clean, dry, sound and offer sufficient profile to achieve adequate adhesion.

Remove all form release agents, curing compounds, salts, efflorescence, laitance, and other foreign matter by sandblasting, shotblasting, mechanical scarification.

Perform this work at no additional cost or change in time. Rinse thoroughly to achieve a final pH as specified by the manufacturer and allow to dry thoroughly prior to coating.

3.02 INSTALLATION

A. Install according to manufacturer's instructions and recommendations.
B. Apply a 5' x 5' test area of each specified coating system to ensure proper adhesion and appearance.

C. Apply first finish coat at rate specified above. Apply second finish coat at rate specified above when first coat is dry, no sooner than 12 hours after completing first coat, but no more than 48 hours.

D. Utilize spike shoes to apply decorative broadcast flakes over concrete coating. Apply flakes as double broadcast to achieve complete coverage of Epoxy Floor Coating.

E. Remain off of floor surface until completely dried.

F. Approval required by Architect of Finish coats of epoxy floor coating prior to applying Urethane Top Coat.

3.03 ADJUST AND CLEAN

A. Assure finish is uniform and consistent.

B. Replace removed plates and covers on floors.

C. Remove surplus materials, rubbish, and debris resulting from installation upon completion of work, and leave areas of installation in neat, clean condition.

D. Clean surface of all debris. Sweep and mop to a smooth, clean appearance.

E. Improper installation or improper use of products will result in the final floor coating to have an undesirable result. If the final surfacing is deemed unacceptable by the Architect, the entire system is to be removed completely, and the substrate properly re-prepped. The system is to be reapplied to an acceptable final result. All costs associated with this procedure are to be at the expense of the contractor with no additional costs to the Owner. The level of acceptability is at the sole discretion of the Architect.
SECTION 101100 - VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Markerboards.
   2. Tackboards.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
   1. Show locations of panel joints.
   2. Include sections of typical trim members.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.

C. Warranties: Sample of special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For visual display surfaces to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of motor-operated, sliding visual display units required for this Project.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

1.6 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Surfaces lose original writing and erasing qualities.
   b. Surfaces exhibit crazing, cracking, or flaking.

2. Warranty Period: 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
   a. Claridge Products and Equipment, Inc.
   b. PolyVision Corporation; a Steelcase company.

B. Melamine: Thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

C. High-Pressure Plastic Laminate: NEMA LD 3.

D. Natural Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish with surface-burning characteristics indicated.

E. Hardboard: ANSI A135.4, tempered.

F. Particleboard: ANSI A208.1, Grade M-1 made with binder containing no urea formaldehyde.

G. Fiberboard: ASTM C 208.
2.2 MARKERBOARD ASSEMBLIES

A. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and 0.021-inch- (0.53-mm-) thick, porcelain-enamel face sheet with low-gloss finish.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Best-Rite Manufacturing.
   b. Claridge Products and Equipment, Inc.
   d. Platinum Visual Systems; a division of ABC School Equipment, Inc.
   e. PolyVision Corporation; a Steelcase company.

2. Manufacturer's Standard Core: Minimum 1/4 inch (6 mm) thick, with manufacturer's standard moisture-barrier backing.
3. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.

2.3 TACKBOARD ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Best-Rite Manufacturing.
   2. Claridge Products and Equipment, Inc.
   5. PolyVision Corporation; a Steelcase company.

B. Natural-Cork Tackboard 1/4-inch- (6-mm-) thick, natural cork sheet factory laminated to 1/4-inch- (6-mm-) thick particleboard backing.

2.4 MARKERBOARD AND TACKBOARD ACCESSORIES

A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- (1.57-mm-) thick, extruded aluminum; standard size and shape.

B. Chalktray: Manufacturer's standard, continuous.
   1. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.

2.5 FABRICATION

A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.

B. Visual Display Boards: Factory assemble visual display boards unless otherwise indicated.
   1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.

C. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.
   1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.7 VISUAL DISPLAY SURFACE SCHEDULE

A. Visual Display Board Factory assembled.
   1. Markerboard: Porcelain-enamel markerboard assembly.
      a. Color: White
   2. Corners: Square
   3. Width: As indicated on Drawings
   4. Height: As indicated on Drawings
   5. Mounting: Wall
   6. Mounting Height: As indicated on Drawings
   8. Accessories:

B. Tackboard Factory assembled.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.

B. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

C. Field-Assembled Visual Display Units: Coordinate field-assembled units with grounds, trim, and accessories indicated. Join parts with a neat, precision fit.

D. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches (400 mm) o.c. Secure both top and bottom of boards to walls.
   a. Attach chalktrays to boards with fasteners at not more than 12 inches (300 mm) o.c.

E. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room. Cover and protect visual display surfaces.

END OF SECTION 101100
SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data, Shop Drawings, and Samples.


PART 2 - PRODUCTS

2.1 SIGNS

A. Interior Panel Signs: Engraved “as shown on sheet A5.1”, plastic laminate with beveled edges and rounded corners.

1. Finishes and Colors: As selected from manufacturers full range.

2. Tactile Characters: For ADA Compliant rooms only. Characters and Grade 2 Braille raised 1/32 inch (0.8 mm) above surface with contrasting colors. Size as shown on sheet A5.1 signs as required at these locations.

3. Provide signs for all rooms mounted on the wall beside the room door. Verify all locations with architect

TYPES OF SIGNS

A. The following signs shall be provided throughout the project, whether indicated or not:

1. All restrooms shall be identified by room name, pictogram, and universal symbol of accessibility.

2. All janitorial and custodial rooms shall be identified by "Custodial", unless otherwise indicated.

3. All mechanical and utility rooms shall be identified by "Mechanical", unless otherwise indicated.

4. All electrical rooms shall be identified by "Electrical", unless otherwise indicated.

5. Typical sign elevations may be indicated on Drawings. See miscellaneous details on Drawings.

SIGN SCHEDULE (ROOM IDENTIFICATION SIGNS)

A. Sign Type: “#1”

Location: Doors A122, A122A

Text: Men
B. Sign Type: “#2”
Location: Doors A119, A119A
Text: Women

C. Sign Type: “#3”
Location: Doors A120, A121, Entrance to Room A111, Entrance to Room A113
Text: To be Determined

D. Sign Type: “#4”
Text: To Be Determined

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. Wall-Mounted Signs:

1. Two-Face Tape: Mount signs to smooth, nonporous surfaces, other than vinyl.

2. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.

3. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes, if required.

END OF SECTION 101400
SECTION 101430 – EXTERIOR SIGNAGE

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Exterior signage as indicated on the Drawings and specified herein, including:
   1. Pre-finished metal lettering.
   2. Pre-finished metal signs and placards.

1.02 RELATED WORK Section 10440 - Interior Signs

1.03 SUBMITTALS

A. Product Data:
   1. Submit manufacturer's product data, cutsheets, specifications and installation details to illustrate conformance with the specifications and for selection and/or verification of all sign layout and construction items.

B. Signage Layout:
   1. Provide initial layout of signage and lettering, including the actual spacing and layout required for the surface to be installed on.
   2. Draw and indicate layout to scale, with field verified measurements included.

C. Mounting Template:
   1. Once a final layout has been approved, supplier shall provide the Contractor with a full scale mounting template for proper positioning of studs and fasteners.

D. Samples:
   1. Submit actual samples of colors as specified. Color charts alone are not acceptable.
   2. If not specified, submit samples of manufacturer's entire selection.
   3. Submit additional actual color samples as requested for selection of verification.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver and store letters in manufacturer's protective packaging.
B. Handle letters so as to prevent damage to finish.
PART 2 - PRODUCTS

MATERIALS
A. Cast Metal Lettering:
   4. Text: As indicated on Drawings.
   5. Size: As indicated on Drawings.
   6. Font: As selected from manufacturer’s entire standard selection.
   7. Finish: Baked enamel finish as indicated on Drawings.
      If not indicated, color and finish to be selected from manufacturer's standard color range.
   9. Fasteners: Manufacturer’s standard concealed anchoring device for wall type.
   10. Setting Cement: As recommended by manufacturer.

SIGN SCHEDULE
A. Material: Cast Metal Lettering
   Text: WOMEN
   Location: Mount on exterior wall at 8'-0" A.F.F. See exterior elevations for further information.
   Size: 8" upper case.
   Font: Arial

B. Material: Cast Metal Lettering
   Text: MEN
   Location: Mount on exterior wall at 8'-0" A.F.F. See exterior elevations for further information.
   Size: 8" upper case.
   Font: Arial

C. Material: Cast Metal Lettering
   Text: CONCESSIONS
   Location: Mount on exterior wall at 8'-0" A.F.F. See exterior elevations for further information.
   Size: 8" upper case.
   Font: Arial

PART 3 - EXECUTION
3.01 INSTALLATION
   A. Masonry Wall:
      1. Drill 3/16" x 1-1/2" deep holes directly in masonry wall.
      2. Set pins in grout.
      3. Mount letters flush with masonry.

END OF SECTION 101430
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, Hiny-Hiders, 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 bracket.

E. Pilaster Shoes: Fabricated from stainless-steel sheet, not less than 3 inches high, finished to match hardware.

F. Brackets (Fittings): Manufacturer's standard full height 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. Full height design, at wall bracket.

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. Wall Brackets: Secure panels to walls and to pilasters with full length brackets. 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 102800 – TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS
   A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 MATERIALS
   A. Stainless Steel: ASTM A 666, Type 304, No. 4 finish (satin), 0.0312-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
   B. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T6 or 6463-T6.
   C. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
   D. Tempered Glass: ASTM C 1048, Kind FT (fully tempered).
   E. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
   G. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.
   H. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

2.2 TOILET AND BATH ACCESSORIES
   A. Available Manufacturers:
      1. Bobrick (Basis of Design)
      2. Bradley Corporation

See drawing Sheet for List of Accessories
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

1. Install grab bars to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

B. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items. Remove temporary labels and protective coatings.

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. Larsen Manufacturing Co., Cameo Series, Model # C2409-6R, steel, w/ 2 ½” rolled edge, bubble design- clear no letters

2. Trim Style: Rolled trim.
3. Door and Trim Material: Enameled steel.
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. Multipurpose Dry-Chemical Type: UL-rated 4-A:80-B:C, 10-lb nominal capacity.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install fire extinguishers in cabinets where indicated on Floor Plan.

END OF SECTION 104416
SECTION 10500 - LOCKERS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Lockers as indicated on the Drawings and specified herein, of the following types:
   1. Metal Athletic Lockers.
   2. Metal Stadium Athletic Lockers.

1.02 RELATED WORK SPECIFIED ELSEWHERE Section 03300 - Concrete.
  Section 06100 - Rough Carpentry.

1.03 SUBMITTALS

A. Shop Drawings:
   1. Indicate sizes, dimensions, gauges, construction, trim, finish and hardware.
   2. Indicate locker numbering sequence.

B. Samples:
   1. Where colors are specified, submit one sample of each color.
   2. Where colors are not specified, or are specified as "to be selected", submit samples showing manufacturer's full range of standard colors for each type.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver fully assembled units to site in undamaged condition, with labels intact.

B. Store and handle materials to avoid damage and exposure to elements.
  Remove damaged otherwise unsuitable material from job site.

1.05 PROJECT CONDITIONS
A. Do not install lockers until space is enclosed and weather-proof, and until wet-work in space is completed, and until temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

PART 2 - PRODUCTS

2.01 METAL ATHLETIC LOCKERS

A. Provide products, as approved by the Architect, from one of the following approved manufacturers:
   1. “DeBourgh”
   2. “List Industries”, “Superior”
   3. “Lyon”
   4. “Penco”
   5. “Republic”
   6. “ASI”

B. Type and Size:
   1. Basis of Specification:
      a. “Republic”; “Heavy-Duty Ventilated Athletic Lockers”.
      b. “Penco”; “Invincible II Heavy-Duty Ventilated Athletic Lockers”.
      c. “Superior”; “Marquis Student HDV”.
   2. Width x depth x height as indicated on Drawings.

C. Doors:
   1. 14 gauge steel, one piece, flanged 4 edges.
   2. Diamond perforated steel.

D. Frame:
   1. 16 gauge steel angle, tee, or channel.

E. Panels:

F. Continuous Sloped Top:
   1. 24 gauge steel, flanged edges.

G. Base:
   1. No integral base.

H. Tops, Bottoms, Shelves:
   1. 16 gauge sheet steel.
   2. Flanged four (4) sides.
   3. Provide sloped top on all units.

I. Hooks:
   1. 3 total, 1 located on each side and back.
   2. Provide at each opening location.

J. Hinges:
   1. 5 knuckle, recessed.
   2. 3 on single tier lockers, 2 on box type lockers.
   3. Provide at each opening location.

K. Silencer:
   1. Air cushion rubber bumpers.
   2. 3 on single tier lockers, 2 on box type lockers.
   3. Provide at each opening location.
L. Number Plate:
   1. Riveted.
   2. Numbered in sequence.
   3. Provide at each opening location.

M. Locking Device:
   1. Architect to select locking during shop drawing submittals.
   2. Built-in combination lock.
   3. Built-in key lock.
   5. Provide at each opening location.

N. Finish:
   1. Baked epoxy enamel.
   2. Color as indicated on drawings, or as selected from manufacturer's entire selection.

O. Handicapped Accessible Lockers:
   1. Provide at locations as indicated on the Drawings or if not indicated, provide a minimum
      of 5% but not less than one of each type specified.
   2. Manufacturer is responsible to provide all modifications as required to meet all
      requirements of the accessibility Code and ADA.
   3. Provide all items within reach heights required.
   4. Provide accessible access control for entry into door without use of combination lock.
      May be accomplished via key fob, card swipe or other method as approved by the Architect.
   5. Provide universal symbol of accessibility on exterior of locker to identify locker meeting
      these requirements for use by disabled students.

2.02 METAL STADIUM ATHLETIC LOCKERS
A. Provide products, as approved by the Architect, from one of the following approved
   manufacturers:
   1. “DeBourgh”
   2. “List Industries”, “Superior”
3. “Lyon”
4. “Penco”
5. “Republic”
6. “ASI”

B. Type and Size:
   1. Basis of specification:
      a. “Republic”; “MVP Athletic Lockers”.
      b. “Superior”; “All-Star Fully-Framed All-Welded Sport Lockers”.
   2. Width x depth x height as indicated on Drawings.
   3. With open top shelf and lockable foot locker.

C. Doors:
   1. Main locker compartment to be open front design, without door.

D. Lockable Foot Locker:
   1. Locked compartment with solid lid located at bottom of locker unit for use as a seat.
   2. 14 gauge sheet steel solid door reinforced lid with continuous piano safety hinges.
   3. 14 gauge sheet steel front panel with mini-louver ventilation.

E. Frame:
   1. 16 gauge steel angle, tee, or channel.

F. Panels:
   1. Sides: 16 gauge sheet steel box ends, diamond perforated steel for ventilation.

G. Tops, Bottoms, Shelves:
   1. 16 gauge sheet steel.
2. Flanged four (4) sides.
3. Provide slope top on all units.

H. Hooks and Rods:
   1. Chrome plated brass or stainless steel coat rod, full width of locker.
   2. 4 total hooks, 1 located on each side and 2 on back.

I. Hinges:
   1. 5 knuckle, recessed.
   2. 2 on each box type locker.

J. Silencer:
   1. Air cushion rubber bumpers.
   2. 2 on each box type locker.

K. Number Plate:
   1. Riveted.
   2. Numbered in sequence.
   3. Provide at each opening location.

L. Locking Device:
   1. Built-in recessed stainless steel hasp area for removable padlock.
   2. Provide on each and all locking compartments.

M. Finish:
   1. Baked epoxy enamel.
   2. Color as indicated on drawings, or as selected from manufacturer's entire selection.

N. Handicapped Accessible Lockers:
1. Provide at locations as indicated on the Drawings or if not indicated, provide a minimum of 5% but not less than one of each type specified.

2. Manufacturer is responsible to provide all modifications as required to meet all requirements of the accessibility Code and ADA.

3. Provide all items within reach heights required.

4. Provide accessible access control for entry into door without use of combination lock. May be accomplished via key fob, card swipe or other method as approved by the Architect.

5. Provide universal symbol of accessibility on exterior of locker to identify locker meeting these requirements for use by disabled students.

2.03 FABRICATION

A. Square and rigid.

B. Interlocked intermediate cross members.

C. All steel to have one-coat electroplated zinc carbon primer. Finish coat as specified. D. Fabricate filler panels from same material as locker units.

PART 3 - EXECUTION

3.01 PREPARATION

A. Field verify all dimensions prior to fabrication.

3.02 INSTALLATION

A. Install lockers in accordance with manufacturer’s instructions and shop drawings.

B. Provide all anchor bolts and other fasteners as required.

C. Provide manufacturer’s standard trim at bottom and sides.

D. Provide filler panels as required.
3.03 ADJUSTING AND CLEANING
   A. Adjust hardware to insure that all doors operate smoothly.

   B. Clean lockers according to manufacturer's recommendations.

3.04 PROTECTION
   A. Protect lockers from damage and deterioration until Substantial completion.

END OF SECTION 10500
SECTION 107500 - FLAGPOLES

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 ground-mounted flagpoles made from aluminum.

B. Owner-Furnished Material: Flags.

C. Related Sections:

1. Section 076200 "Sheet Metal Flashing and Trim" for counterflashing flashing at roof-mounted flagpoles.
2. Section 264113 "Lightning Protection for Structures" for connecting wall- and roof-mounted metal flagpoles to lightning protection system.
3. Section 265600 "Exterior Lighting" for site lighting fixtures.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Flagpole assemblies, including anchorage and supports, shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to the following design criteria:

1. Seismic Loads: \( S_s=0.496g; S_1=0.160g \) according to 2015 NEHRP.
2. Wind Loads: 90mph, 23 psf @ 30' hat according to NAAMM FP 1001, "Guide Specifications for Design of Metal Flagpoles."
3. Base flagpole design on polyester nylon or cotton flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

B. Shop Drawings: For flagpoles. Include plans, elevations, details, and attachments to other work. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.
1. Include section, and details of foundation system for ground-mounted flagpoles.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

1.5 INFORMATIONAL SUBMITTALS
A. Qualification Data: For qualified professional engineer.

1.6 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE
A. Source Limitations: Obtain flagpole as complete unit, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING
A. General: Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

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. American Flagpole; a Kearney-National Inc. company.
2. Atlantic Fiberglass Products, Inc.
4. Concord Industries, Inc.
5. Eder Flag Manufacturing Company, Inc.
7. Lingo Inc.; Acme Flagpole Company Division.
9. Morgan-Francis; Division of Original Tractor Cab Co., Inc.
10. PLP Composite Technologies, Inc.
12. U.S. Flag & Flagpole Supply, LP.
13. USS Manufacturing Inc.
2.2 FLAGPOLES

A. Flagpole Construction, General: Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:

1. Fabricate shop and field joints without using fasteners, screw collars, or lead caulking.

B. Exposed Height: 30 feet (9 m)

C. Aluminum Flagpoles: Provide cone-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B 241/B 241M, Alloy 6063, with a minimum wall thickness of 3/16 inch (4.8 mm).

D. Cast-Metal Shoe Base: For anchor-bolt mounting; provide with anchor bolts.

1. Provide units made from aluminum steel with same finish and color as flagpoles
2. Provide ground spike at grade-mounted flagpoles.
3. Provide connector to building’s lightning protection system conductor at roof-mounted flagpoles.

2.3 FITTINGS

A. Finial Ball: Manufacturer's standard flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.

1. 0.063-inch (1.6-mm) spun aluminum, finished to match flagpole.

B. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Provide flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

1. Halyard Flag Snaps: Provide two stainless-steel swivel snap hooks per halyard.
   a. Provide with neoprene or vinyl covers.

2. Plastic Halyard Flag Clips: Made from injection-molded, UV-stabilized, acetal resin (Delrin). Clips attach to flag and have two eyes for inserting both runs of halyards. Provide two flag clips per halyard.
   a. Product: Subject to compliance with requirements, provide "Quiet Halyard" flag clasp by Lingo.
2.4 MISCELLANEOUS MATERIALS


B. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.

C. Sand: ASTM C 33, fine aggregate.

D. Elastomeric Joint Sealant: Single-component nonsag urethane joint sealant complying with requirements in Section 079200 "Joint Sealants" for Use NT (nontraffic) and for Use M, G, A, and, as applicable to joint substrates indicated, for Use O.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
   1. Color: Clear Anodized

B. Gold Anodic Finish: AAMA 611, AA-M32C22A43 Class I, 0.018 mm or thicker; gold color.

2.7 STEEL FINISHES

A. Flagpole Interior Finish: Apply one coat of bituminous paint on interior of flagpole or otherwise treat to prevent corrosion.

B. Galvanized Finish: Hot-dip galvanize after fabrication to comply with ASTM A 123/A 123M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including foundation; accurate placement,
pattern, orientation of anchor bolts, and other conditions affecting performance of the Work.

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

3.2 PREPARATION
A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.

B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.

C. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.

D. Place concrete, as specified in Section 033000 "Cast-in-Place Concrete" Compact concrete in place by using vibrators. Moist-cure exposed concrete for not less than seven days or use nonstaining curing compound.

E. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.3 FLAGPOLE INSTALLATION
A. General: Install flagpoles where shown and according to manufacturer’s written instructions.

B. Baseplate: Cast anchor bolts in concrete foundation. Install baseplate on washers placed over leveling nuts on anchor bolts and adjust until flagpole is plumb. After flagpole is plumb, tighten retaining nuts and fill space under baseplate solidly with nonshrink, nonmetallic grout. Finish exposed grout surfaces smooth and slope 45 degrees away from edges of baseplate.
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.
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.


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.


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.
   2. Design Mix: 5000-psi, 28-day compressive strength.

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.


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.

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.
   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."

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:
   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:
   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:
   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.
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.

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.

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.

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:
      b. SWP Rating: 150 psig.
      c. CWP Rating: 600 psig.
      d. Body Design: Two piece.
      e. Body Material: Forged brass.
      f. Ends: Threaded.
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:

   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 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.
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.
   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.
   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.
   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.

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.

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 bronze and brass trim.

B. Pipe NPS 2-1/2 and Larger:
   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.
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
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.

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 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.
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.
   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.

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.
   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.
   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.

B. Pipe Label Color Schedule:

1. Domestic Water Piping:
   b. Letter Color: Black.

2. Sanitary Waste, Vent and Storm Drainage Piping:
   b. Letter Color: Green.

3. Fire Protection
   b. Letter Color: Red.

4. Gas Piping:
   b. Letter Color: Green.

5. Radon Vent Piping “radon reduction system”
   a. Background Color: White
   b. Letter Color: Yellow

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.

   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.

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.

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.
   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.
   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.
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.
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."

PLUMBING INSULATION
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 – EXTERIOR FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Summary: This Section includes water-distribution piping outside the building for combined water service and fire-service mains.

B. Submittals:
   1. Product Data: For each type of product indicated.

1.2 FIELD CONDITIONS

A. Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and only after arranging to provide temporary water-distribution service according to requirements indicated:
   1. Notify Architect no fewer than two days in advance of proposed interruption of service, and do not proceed without written permission.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

2.2 PIPE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

2.3 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8, BCuP Series.
2.4 VALVES

A. AWWA, Cast-Iron Gate Valves: Nonrising-stem, resilient-seated gate valves.
   1. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
      c. End Connections: Mechanical joint.
      d. Interior Coating: Complying with AWWA C550.

B. UL/FMG, Nonrising-Stem Gate Valves: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.
   1. Standards: UL 262 and FMG approved.

C. Bronze Gate Valves: Nonrising-stem, Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel; complying with MSS SP-80.

2.5 VALVE ACCESSORIES AND SPECIALTIES

A. Valve Boxes:
   1. Comply with AWWA M44 for cast-iron valve boxes.
   2. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.
   3. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

B. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

B. Water-Main Connection: Arrange with Owner for tap of size and in location indicated in water main.

C. Comply with NFPA 24 for fire-service-main piping materials and installation.
   1. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

D. Bury piping with depth of cover over top at least 48 inches, with top at least 12 inches below level of maximum frost penetration.

E. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
   1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

F. Sleeves are specified in Section 220500 "Common Work Results for Plumbing"

G. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

H. Anchorage, General: Install water-distribution piping with restrained joints. As required by authorities having jurisdiction.

3.2 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

C. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

D. Install water meters, piping, and specialties according to utility company's written instructions.

E. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect water-distribution piping to utility water main.

C. Connect water-distribution piping to interior domestic water piping.

3.4 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

1. Prepare reports of testing activities.

3.5 IDENTIFICATION

A. Install continuous underground warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

3.6 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.

B. Prepare reports of purging and disinfecting activities.

3.7 PIPING APPLICATION SCHEDULE

A. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

B. Do not use flanges or unions for underground piping.

C. Flanges, unions, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

D. Underground water-service piping: Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

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.


F. Copper Unions:
   1. MSS SP-123.
   4. Solder-joint or threaded ends.

2.3 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.

   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."
2.4 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.

2.5 TRANSITION FITTINGS

A. General Requirements:
   1. Same size as pipes to be joined.
   2. Pressure rating at least equal to pipes to be joined.
   3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. 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):
      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.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric 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.

2.7 FLEXIBLE CONNECTORS

A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.


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.


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:
   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.

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.

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.
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.

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:

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.
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.
   c. Zurn Plumbing Products Group; Wilkins Div.

3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
5. Inlet and Outlet Connections: Threaded.

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.
   c. Woodford Manufacturing Company.
   d. Zurn Plumbing Products Group; Wilkins Div.

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):
   b. Zurn Plumbing Products Group; Wilkins Div.
   c. MIFAB

2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
5. Body: Bronze.
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):
   b. Zurn Plumbing Products Group; Wilkins Div.
   c. MIFAB
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.
   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):
   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:
      2. Pressure Rating: 400-psig minimum CWP.
      4. Body: Copper alloy.
      5. Ball: Chrome-plated brass.
      8. Inlet: Threaded or solder joint.

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):
         b. MIFAB, Inc.
         c. Sioux Chief Manufacturing Company, Inc.
         e. Watts Drainage Products Inc.
         f. Zurn Plumbing Products Group; Specification Drainage Operation.
         g. Wade.
      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 SECTION REQUIREMENTS

A. Submittals:
   1. Product Data: For each type of pipe & fitting.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. PVC Type PSM Sewer Pipe and Fittings: ASTM D 3034, SDR 35, for gasketed joints. Include ASTM F 477 elastomeric seals.

B. Cast-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug. Use units with heavy-duty top-loading classification in vehicle-traffic service areas and medium-duty in paved foot-traffic areas.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream.

B. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

C. Install piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated, with 36-inch minimum cover.

D. Install ABS and PVC sewer piping according to ASTM D 2321 and ASTM F 1668.

E. Install cleanout and extension to grade at connection of building sanitary drain and building sanitary sewer.

F. Make connections to existing piping and underground manholes.
   1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and
encase entire wye fitting plus 6-inch overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

3.2 FIELD QUALITY CONTROL

A. Clean and inspect piping and structures.

B. Test complete piping according to authorities having jurisdiction.
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:

1.3 QUALITY ASSURANCE

   A. Piping materials shall bear label, stamp, or other markings of specified testing agency.


   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.
SANITARY WASTE AND VENT PIPING

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS


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.
   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


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:

      2) Fernco Inc.
      3) Mission Rubber Company; a division of MCP Industries, Inc.
      4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.


   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:

      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:

      2) Mission Rubber Company; a division of MCP Industries, Inc.


   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."

   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,
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 6 and 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 35 feet. 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 35 feet. 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.
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.

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):
         b. MIFAB.
         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.
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):
   b. MIFAB.
   c. Sioux Chief Manufacturing Company, 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.
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):
   b. MIFAB
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.

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: Counterflashin-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


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.


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:
      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.
      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.

B. Copper Pipe Hangers:
   1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

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.
      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 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)

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.

C. Factory Mutual (FM)

   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:

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.

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.
D. Nuts: to ASTM A563.

2.4 INSULATION PROTECTION SHIELDS

A. Insulated cold piping:
   1. 64 kg/m³ 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.

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.

<table>
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<tr>
<th>Maximum Pipe Size: NPS</th>
<th>Maximum Spacing: Steel</th>
<th>Maximum Spacing: Copper</th>
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<td>up to 1-1/4</td>
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<td>3-1/2</td>
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<td>Maximum Spacing: Steel</td>
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<td>12</td>
<td>6.9 m</td>
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</tr>
</tbody>
</table>

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 angle 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.
   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.

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


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:

<table>
<thead>
<tr>
<th>Outside Diameter of Insulation or Pipe</th>
<th>Color Field Length</th>
<th>Letter Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>¾ to 1-1/4 inches (9.5 to 31.7 mm)</td>
<td>8 inches (200 mm)</td>
<td>½ inch (13 mm)</td>
</tr>
<tr>
<td>1-1/2 to 2 inches (38.1 to 50.8 mm)</td>
<td>8 inches (200 mm)</td>
<td>¾ inch (20 mm)</td>
</tr>
<tr>
<td>2-1/2 to 2 inches (63.5 to 50.8 mm)</td>
<td>12 inches (300 mm)</td>
<td>1 ¼ inch (32 mm)</td>
</tr>
<tr>
<td>8 to 10 inches (203.2 to 254 mm)</td>
<td>24 inches (600 mm)</td>
<td>2 ½ inch (64 mm)</td>
</tr>
<tr>
<td>Over 10 inches (254 mm)</td>
<td>32 inches (800 mm)</td>
<td>3 inches (75 mm)</td>
</tr>
<tr>
<td>Ductwork and equipment</td>
<td>---</td>
<td>2 ½ inch (64 mm)</td>
</tr>
</tbody>
</table>

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.


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
   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.

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 louveres 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.
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 current 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.
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.

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.

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
SECTI0N 230713 – DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Insulation Materials:
   2. Fire-rated insulation systems.
   3. Adhesives.
   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


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 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):

      b. Eagle Bridges - Marathon Industries; 225.
      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."


   1. Products: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):

      b. Eagle Bridges - Marathon Industries; 225.
      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.
   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):

   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.
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):
   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):
DUCT INSULATION 230713 - 6

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):

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.

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>
<thead>
<tr>
<th>HVAC Systems</th>
<th>Insulation Types (1)</th>
<th>Density (lbs./cu.Ft.)</th>
<th>Insulation Thickness</th>
<th>Vapor Barrier Requirements (2)</th>
<th>Jacket Types (3)</th>
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<tr>
<td>Refrigerant Suction piping</td>
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<td>AL or SS</td>
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(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 insulation 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 230913 – AUTOMATIC TEMPERATURE CONTROL SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Extend existing high school DDC Andover Controls Continuum Control System into new locker room facility. Existing 4” conduit provided, to be shared with fire alarm and communications.

B. Provide for new controllers, network cabling, sensors, dampers, actuators, software, etc. required for DDC control of new AHU’s, CU, HP, fan coils, & ERV, etc.

C. Provide and install the most current updates at the time of installation. Contractor shall include costs for providing and installing all updates for two years beyond the date of substantial completion.

D. Submit for approval critical vs. common alarms list for each location. List shall be reviewed with additions/subtractions by Owner’s Representative.

1.2 SECTION INCLUDES

A. Complete Building Automation System (BAS) to integrate the operation of stand-alone distributed direct digital controllers including:

1. Central Operating Stations.
2. Remote Terminal Stations.
4. Central Operators Station Software.
5. DDC Terminal Unit Controls.
7. Final adjustments and technical checkout.
10. System license.

B. All required interface and coordination with building automation system and mechanical equipment supplied by other contracts.

C. Terminal unit controls for RTU’s, fans, electrically controlled unless indicated otherwise.

D. All wiring, piping, labor and installation to complete all temperature control and automation functions.
E. All automated dampers, damper motors, and valve operators.

F. System Start-up and Checkout.

G. Instructions for Owner.

H. Owner Training

1.3 RELATED SECTIONS

A. Section 23 05 00 - General Mechanical Requirements.

B. Section 23 05 49 - Vibration Isolation.

C. Section 23 73 00 – Packaged Air Handling Units with Coils.

D. Section 23 09 93 - Sequence of Operations.

E. Section 23 05 93 - Testing, Adjusting and Balancing.

F. Division 26 - Electrical Work.

1.4 REFERENCES

A. ASTM D1693 - Environmental Stress-Cracking of Ethylene Plastics.

1.5 SUBMITTALS

A. Submit shop drawings and product submittal under provisions of Division 1.

B. Provide job-tailored shop drawings as detailed herein, individual catalog cut-sheets detailing manufacturer’s data for each major control system component, general catalog for all other minor control components and descriptive sequences detailing all BAS/TCS work.

C. Generalized, standard catalog shop drawings shall not be used. This contractor shall develop a complete set of new shop drawings showing the entire BAS/TCS.

D. Each mechanical system shall be represented by a line diagram showing each mechanical component as well as any other mechanical system components present but not necessarily affected by the BAS/TCS (filters, etc.).

E. A line diagram representation of the respective mechanical system shall show all valves as they are intended to be connected to their respective mechanical component for proper operation.
F. A line diagram representation of the respective mechanical system shall also show all field-mounted BAS/TCS sensing and control components (sensors, transmitters, etc.) and all controlled devices (pressure-electric switches, electric-pressure solenoids, valve actuators, etc.).

G. All panel-mounted control components shall be shown within a separate section of the shop drawing designated for representation of the individual local control panel and its face layout; interconnecting pneumatic piping between panel-mounted components shall be shown within the panel layout and interconnecting electrical wiring shall be shown on a one-line diagram (complete with terminal designations) on the same drawing.

H. All electrical wiring for starters of mechanical system components affected by the BAS/TCS (chillers, cooling towers, pumps, etc.) shall be represented as one-line diagrams showing all interlocks between the BAS/TCS, the respective starter and any other interlocks not necessarily provided as part of the BAS/TCS (fire alarm, smoke alarm, etc.).

I. Each shop drawing shall be accompanied by a type-written listing identifying each BAS/TCS component shown on that drawing; each component shall be identified by the name used to designate the component on the shop drawings, the component's actual catalog description and designation (to be used when purchasing repair parts), the component's operating range, the component's fail-safe position, the component's setpoint (where applicable) and any other pertinent information.

J. Each shop drawing shall be accompanied by a type-written sequence of operation identifying the designated function of each control component shown on that drawing; each control component shall be identified in the sequence of operation by the name used to designate the component on the shop drawings.

K. For each system controlled by a field programmed direct digital control, provide the software program listing and the configuration data for each input and output point including hardware name, software name, range and fail condition. Software program listing shall include complete list of all program variables with software name and program function.

L. Submit on one drawing a complete system architectural drawing indicating physical location, system addresses, and communication technique for all system components including DDC controllers, central operator station, remote terminals, modems, and other communication devices connected to the system network.

M. Submit complete electrical wiring diagrams showing all communication and electrical wiring for all components attached to the system network.

N. Submittals shall be provided to and approved by the Owner's authorized representative before any jobsite installation work is performed.

O. For each system, submit a detailed checkout procedure. Identify step-by-step procedures to fully test and simulate system normal, alarm, and failure sequences.
Include for each system a listing of all hardware point addresses, corresponding software point names, alarm setpoints, totalization point names, and all associated graphics and reports where point data occurs.

1.6 PROJECT RECORD DOCUMENTS

A. Submit record documents under provisions of Division 1.

B. Accurately record actual location of control component, including panels, thermostats, and sensors.

C. Revise shop drawings to reflect actual installation and operating sequences.

D. Maintain at the jobsite, marked-up shop drawings showing actual job progress and installations.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 1.

B. Provide after all installation, calibration and start-up work has been completed. Include submittal shop drawings of the BAS/TCS, revised to reflect the system in its as-built condition, along with all information previously included in the first phase submittals.

C. Include a type-written set of operating instructions identifying the procedures to be employed to perform such BAS/TCS operations as overriding the system, adjusting setpoints, displaying current values of system parameters, displaying trend logs, etc.

D. Include information detailing preventative maintenance procedures to be performed on a regular basis and the Subcontractor's system guarantee and system component warranties. Submit a Schedule of Maintenance Inspections to be performed under this Contract.

E. Provide submittals in a binder labeled with the title of the project.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five (5) years experience.

B. Installer: Company specializing in installing the work of this Section with minimum five (5) years experience and approved by manufacturer.
1.9 SEQUENCING AND SCHEDULING

A. Sequence work under the provisions of Division 1.
B. Schedule work under provisions of Division 1.
C. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
D. Coordinate work under provisions of Division 1, and ensure system is completed and commissioned by Date of Substantial Completion.
E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

1.10 REGULATORY REQUIREMENTS

A. Standard Specifications and Codes: In addition to the requirements shown or specified, comply with the following latest current applicable standard specifications, codes or ordinances.

2. UL - Underwriters’ Laboratories.
3. IMC - Indiana Mechanical Code.

B. Include all items of labor and material required to comply with such standards, codes or ordinances in accordance with the contract documents. Where quantities, sizes, or other requirements indicated on Drawings or herein specified are in excess of the standard or code requirements, the specifications and drawings shall govern.

1.11 WARRANTY

A. Provide two (2) years parts and labor warranty under provisions of Division 1 from date of Owner acceptance (Final Payment) of system operation.
B. Date of Owner acceptance of system operation shall be determined by the Owner's representative. Written confirmation of system acceptance shall be provided to the contractor.
C. Provide twenty-four (24) hour on site response to service request calls from the time of initial customer contact, including weekends and holidays.
D. Provide software upgrades for all DDC, auxiliary devices, and system components to the manufactures current revision level for the full warranty period.
E. Provide upgraded and revised system documentation for all modifications and additions for the full warranty period.

F. Warranty: Include coverage for control air compressors, all system terminals, all portable devices and miscellaneous devices supplied by this contractor.

1.12 MAINTENANCE SERVICE

A. Furnish complete service and preventative maintenance of automatic controls system for two (2) years from Date of final acceptance/final payment. Provide twenty-four (24) hour on site response to service request calls from the time of initial customer contact, including weekends and holidays.

B. A preventive maintenance and support agreement shall be included at no additional cost to the Owner. This agreement shall begin at acceptance of the Building Automation System by the Owner and conclude at the end of the warranty period. This agreement shall include the following for each piece of equipment listed that applies to the building.

   1. Remote polling and review of trends. Trends shall include but not be limited to the points listed on Drawings. These trends will be polled on a monthly basis for review and sent to the Owner for their review.

   2. Technician will consult with Owner or Owner’s Representative to address any desired changes to the system. Technician will also advise or recommend to customer ways to enhance operation of the current system, if applicable.

C. Make minimum of six complete normal inspections per year in addition to normal and emergency service calls to inspect, calibrate and adjust controls and verify software operation. Submit written reports.

1.13 CUSTOMER TRAINING

A. Provide not less than eight (8) hours of customer operational training at the customers site on the Owner's system. The training shall be provided at the Owner's convenience in four (4) hour increments. The training may occur during nonstandard work hours. The training shall be divided into general system operation and specific air handler and control system operation.

B. Provide a minimum of eight (8) hours of system hardware trouble shooting training at the customer’s site. The training shall be provided at the Owner's convenience in two (2) hour increments. Training may occur during nonstandard work hours.

1.14 DEFINITIONS

A. DDC: Direct digital control.
B. I/O: Input/output.
C. MS/TP: Master slave/token passing.
D. PC: Laptop computer.
E. PID: Proportional plus integral plus derivative.
F. RTD: Resistance temperature detector.

1.15 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.

2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.

3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.

4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.

5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.

6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.

7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.

8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:

   a. Water Temperature: Plus or minus 1 deg F (0.5 deg C).
   b. Water Flow: Plus or minus 5 percent of full scale.
   c. Water Pressure: Plus or minus 2 percent of full scale.
   d. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
   e. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
   f. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
   g. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).
   h. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
   i. Relative Humidity: Plus or minus 5 percent.
   j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
l. Airflow (Terminal): Plus or minus 10 percent of full scale.
m. Air Pressure (Space): Plus or minus 0.01-inch wg (2.5 Pa).
n. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).
o. Carbon Monoxide: Plus or minus 5 percent of reading.
p. Carbon Dioxide: Plus or minus 50 ppm.
q. Electrical: Plus or minus 5 percent of reading.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Andover Controls “Continuum” DDC Control System

B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.2 ACCEPTABLE MANUFACTURERS

A. Andover Controls

2.3 DDC EQUIPMENT

1. Application Software:

   a. I/O capability from operator station.
   b. System security for each operator via software password and access levels.
   c. Automatic system diagnostics; monitor system and report failures.
   d. Database creation and support.
   e. Automatic and manual database save and restore.
   f. Dynamic color graphic displays with up to 10 screen displays at once.
   g. Custom graphics generation and graphics library of HVAC equipment and symbols.
   h. Alarm processing, messages, and reactions.
   i. Trend logs retrievable in spreadsheets and database programs.
   j. Alarm and event processing.
k. Object and property status and control.
l. Automatic restart of field equipment on restoration of power.
m. Data collection, reports, and logs. Include standard reports for the following:

1) Current values of all objects.
2) Current alarm summary.
3) Disabled objects.
4) Alarm lockout objects.
5) Logs.
n. Custom report development.
o. Utility and weather reports.
p. Workstation application editors for controllers and schedules.
q. Maintenance management.
r. Provide any and all program usernames, keys, passwords. Owner shall be granted ALL permissions, rights and licenses and have the capability of full and complete control to revise, adjust, review, etc. any and all programs. Provide and install the most current software program/upgrade to the Owner's existing Tridium system.

2. Custom Application Software:

a. English language oriented.
b. Full-screen character editor/programming environment.
c. Allow development of independently executing program modules with debugging/simulation capability.
d. Support conditional statements.
e. Support floating-point arithmetic with mathematic functions.
f. Contains predefined time variables.

B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random access memory; local operator access and display panel; integral interface equipment; and backup power source.

1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

a. Global communications.
b. Discrete/digital, analog, and pulse I/O.
c. Monitoring, controlling, or addressing data points.
d. Software applications, scheduling, and alarm processing.
e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

3. Standard Application Programs:
a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
e. Remote communications.
f. Maintenance management.
g. Units of Measure: Inch-pound and SI (metric).

4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
6. LonWorks or BacNet Compliance: Control units shall use LonTalk or BacNet protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.

C. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.

1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
   a. Global communications.
   b. Discrete/digital, analog, and pulse I/O.
   c. Monitoring, controlling, or addressing data points.
3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
5. LonWorks or BacNet Compliance: Control units shall use LonTalk or BacNet protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.

D. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation.
5. Analog Outputs: Provide modulating signal, either low voltage 0- to 10-V dc or current 4 to 20 mA.
7. Universal I/Os: Provide software selectable binary or analog outputs.

2.4 ANALOG CONTROLLERS

A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.

B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F, and single- or double-pole contacts.

C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
   1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

E. Receiver Controllers: Single- or multiple-input models with control-point adjustment, direct or reverse acting with mechanical set-point adjustment with locking device, proportional band adjustment, authority adjustment, and proportional control mode.
   1. Remote-control-point adjustment shall be plus or minus 20 percent of sensor span, input signal of 3 to 13 psig.
   2. Proportional band shall extend from 2 to 20 percent for 5 psig.
   3. Authority shall be 20 to 200 percent.
   4. Air-supply pressure of 18 psig, input signal of 3 to 15 psig, and output signal of zero to supply pressure.
   5. Gages: [1-1/2 inches] [2-1/2 inches] [3-1/2 inches] in diameter, 2.5 percent wide-scale accuracy, and range to match transmitter input or output pressure.

2.5 TIME CLOCKS

A. Manufacturers:
   1. ATC-Diversified Electronics.
2. Paragon Electric Co., Inc.
3. Precision Multiple Controls, Inc.
4. SSAC Inc.; ABB USA.
5. TCS/Basys Controls.
6. Time Mark Corporation.

B. Seven-day, programming-switch timer with synchronous-timing motor and seven-day dial; continuously charged, nickel-cadmium-battery-driven, eight-hour, power-failure carryover; multiple-switch tripers; minimum of two and maximum of eight signals per day with two normally open and two normally closed output contacts.

C. Solid-state, programmable time control with 4 separate programs each with up to 100 on-off operations; 1-second resolution; lithium battery backup; keyboard interface and manual override; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; system fault alarm; and communications package allowing networking of time controls and programming from PC.

2.6 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting.

B. Thermistor Temperature Sensors and Transmitters:
   1. Manufacturers:
      a. BEC Controls Corporation.
      b. Ebtron, Inc.
      c. Heat-Timer Corporation.
      d. I.T.M. Instruments Inc.
      e. MAMAC Systems, Inc.
      f. RDF Corporation.
   2. Accuracy: Plus or minus 0.5 deg F at calibration point.
   4. Insertion Elements in Ducts: Single point, 8 inches 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
   5. Averaging Elements in Ducts: use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
   6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
   7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
      a. Set-Point Adjustment: Concealed.
      b. Set-Point Indication: Concealed.
      c. Thermometer: Concealed.
   8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

C. RTDs and Transmitters:

1. Manufacturers:
   a. BEC Controls Corporation.
   b. MAMAC Systems, Inc.
   c. RDF Corporation.

2. Accuracy: Plus or minus 0.2 percent at calibration point.
4. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
5. Averaging Elements in Ducts: 24 feet long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length.
6. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
   a. Set-Point Adjustment: Concealed.
   b. Set-Point Indication: Concealed.
   c. Thermometer: Concealed.

8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

D. Humidity Sensors: Bulk polymer sensor element.

1. Manufacturers:
   a. BEC Controls Corporation.
   b. General Eastern Instruments.
   c. MAMAC Systems, Inc.
   d. ROTRONIC Instrument Corp.
   e. TCS/Basys Controls.
   f. Vaisala.

2. Accuracy: 5 percent full range with linear output.
3. Room Sensor Range: 20 to 80 percent relative humidity.
4. Room Sensor Cover Construction: Manufacturer's standard locking covers.
   a. Set-Point Adjustment: Concealed.
   b. Set-Point Indication: Concealed.

5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F.
7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:

1. Manufacturers:
   a. BEC Controls Corporation.
   b. General Eastern Instruments.
   c. MAMAC Systems, Inc.
   d. ROTRONIC Instrument Corp.
   e. TCS/Basys Controls.
   f. Vaisala.

2. Static-Pressure Transmitter: Non-directional sensor with suitable range for expected input, and temperature compensated.
   a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
   b. Output: 4 to 20 mA.
   c. Building Static-Pressure Range: 0- to 0.25-inch wg.
   d. Duct Static-Pressure Range: 0- to 5-inch wg.

3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

F. Room Sensor Cover Construction: Manufacturer's standard locking covers.

G. Room sensor accessories include the following:

1. Insulating Bases: For sensors located on exterior walls.
2. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base.
3. Adjusting Key: For calibration and cover screws.

2.7 FLOW MEASURING STATIONS

A. Duct Airflow Station: Combination of air straightener and multiport, self-averaging pitot tube station.
1. Manufacturers:
   a. Air Monitor Corporation.
   b. Wetmaster Co., Ltd.
   c. Trane

2. Casing: Galvanized-steel frame.


4. Sensing Manifold: Copper manifold with bullet-nosed static pressure sensors positioned on equal area basis.

2.8 HUMIDITY, TEMPERATURE, CARBON DIOXIDE SENSORS

A. Manufacturers:
   1. Vaisala GMW90 of approved equal.

2.9 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
   1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
   3. Non-spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
   4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
   5. Non-spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
   6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
   1. Manufacturers:
      a. Belimo Aircontrols (USA), Inc.
   2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
   3. Dampers: Size for running torque calculated as follows:

5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
7. Power Requirements (Two-Position Spring Return): 24 or 120-V ac.
8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
10. Temperature Rating: 40 to 104 deg F
11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.

2.10 CONTROL VALVES

A. Manufacturers:
   2. Erie Controls.
   3. Hayward Industrial Products, Inc.
   5. Neles-Jamesbury.
   6. Parker Hannifin Corporation; Skinner Valve Division.
   7. Pneuline Controls.
   8. Sauter Controls Corporation.

B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

C. Butterfly Valves: 200-psig, 150-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
   1. Sizing: 1-psig maximum pressure drop at design flow rate.

D. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
   1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
   2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
   3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

E. Self-Contained Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.

2.11 DAMPERS

A. Manufacturers:
   1. Air Balance Inc.
   2. TAMCO (T. A. Morrison & Co. Inc.).
   3. United Enertech Corp.

B. Dampers: AMCA-rated, opposed-blade design; 0.108-inch- minimum thick, galvanized-steel or 0.125-inch- minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.

1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.12 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

B. All new wiring, control cable, etc. shall be plenum rated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation.

B. Verify that pneumatic piping and duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.
3.2 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Mount compressor and tank unit on spring isolators with 1-inch static deflection. Vibration isolators are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Isolate air supply with wire-braid-reinforced rubber hose. Secure and anchor according to manufacturer's written instructions and seismic-control requirements.

1. Pipe manual and automatic drains to nearest floor drain.
2. Supply instrument air from compressor units through filter, pressure-reducing valve, and pressure relief valve, with pressure gages and shut off and bypass valves.

D. Verify location of thermostats, humidistats, CO2 sensors and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor or as indicated on drawings.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

E. Install guards on thermostats in the following locations:

1. Entrances.
2. Public areas.
3. Where indicated.

F. Install automatic dampers according to Division 23 Section "Air Duct Accessories."

G. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

H. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

I. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

J. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."
3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. 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 unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test proper shut-down initiation by smoke detector activation.
4. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
5. Pressure test control air piping at 30 psig or 1.5 times the operating pressure for 24 hours, with maximum 5-psig loss.
6. Pressure test high-pressure control air piping at 150 psig and low-pressure control air piping at 30 psig for 2 hours, with maximum 1-psig loss.
7. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
8. Test each point through its full operating range to verify that safety and operating control set points are as required.
9. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
10. Test each system for compliance with sequence of operation.
11. Test software and hardware interlocks.

C. DDC Verification:
1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check installation of air supply for each instrument.
6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
8. Check temperature instruments and material and length of sensing elements.
9. Check control valves. Verify that they are in correct direction.
10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
11. Check DDC system as follows:
   a. Verify that DDC controller power supply is from emergency power supply, if applicable.
   b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
   c. Verify that spare I/O capacity has been provided.
   d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:
1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
   a. Check analog inputs at 0, 50, and 100 percent of span.
   b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
   c. Check digital inputs using jumper wire.
   d. Check digital outputs using ohmmeter to test for contact making or breaking.
   e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:
   a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
   b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:
   a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
   b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:
   a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
   b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 24 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

D. Provide a (2) year warranty for parts and labor for complete installation of new equipment and software.
SECTION 230993 – SEQUENCE OF OPERATION

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 control sequences for HVAC systems, subsystems, and equipment.
   B. Related Sections include the following:
      A. Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 FURNACE/AIR COOLED CONDENSER
   A. Provide for automatic control of all furnace and air cooled condenser.
   B. Provide wall mount thermostats to automatically control fan coil/air cooled condenser.
   C. Fans shall operate continuous in occupied mode. Gas burner and refrigerant compressor shall cycle to offset space heat gains/losses.
   D. Fans shall cycle, in unoccupied mode. Gas burner and refrigerant compressor shall cycle to offset zone heat gains/losses. Temperature setpoints and time schedules shall be adjustable.
   E. Provide for 2-stage cooling at each AHU/CU.

3.2 HEAT PUMP/FAN COIL
   A. Provide for automatic control to HP/FC to start heat/cool as 3rd stage heat/cool for locker rooms.
3.3 **ERV**

A. AHU & ERV supply/return fans shall operate continuously during Occupied mode and interlocked AHU operation. AHU shall cycle to offset space heat gains/losses during Unoccupied periods. ERV shall operate as a 2-speed unit to match 2-stage heat/cooling of the AHU. ERV to shut down in unoccupied mode and bypass damper to open to bypass exhaust air to AHU return. Damper to automatically close with return to occupied setting.

3.4 **UNIT HEATERS**

A. Where electric thermostats are shown on plans, each unit shall be controlled by a single temperature line voltage thermostat furnished and installed by Temperature Control Contractor and arranged to cycle fan. Where thermostats are not shown on Drawings, each unit shall be controlled by a single temperature line voltage thermostat furnished and installed on the casing of the unit heater by Temperature Control Contractor.

B. Certain entry units have specific mounting requirements for the associated space thermostat. Refer to the drawings and coordinate the installation closely with the other trades and the Engineer.

3.5 **WH COMBUSTION AIR**

A. Dampers shall operate automatically to open/close with burner operation.

3.6 **START-UP / TESTING**

A. The Building Control 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.
3.7 TRAINING

A. At the completion of the project, TCC shall provide 16 hours of training for the Building Control System. The training shall be presented in four (4) 4-hour sessions as selected by the owner.

END OF SECTION 230993
SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:
   1. Product Data: For each type of product indicated.
   2. Shop Drawings: For facility natural-gas piping layout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:
   1. Piping and Valves: 100 psig minimum unless otherwise indicated.
   2. Service Regulators: 65 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressure within Building: One distribution pressure. More than 0.5 psig, but not more than 2.0 psig.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
   4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

2.3 SPECIALTIES

A. Appliance Flexible Connectors:
   4. Corrugated stainless-steel tubing with polymer coating.
B. Strainers: ASTM A 126, Class B, cast-iron body, Y-pattern, full size of connecting piping, CWP rating of 125 psig. Include 40-mesh startup strainer, and perforated stainless-steel basket.

C. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

D. Service Meters: Comply with gas company requirements.

E. Detectable Warning Tape: PE film warning tape 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection; colored yellow.

2.4 VALVES


1. CWP Rating: 125 psig.

B. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Body: Cast iron, complying with ASTM A 126, Class B.
2. Plug: Bronze or nickel-plated cast iron.
3. Seat: Coated with thermoplastic.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

C. Electrically Operated, Automatic Gas Valves: Comply with UL 429.

2.5 PRESSURE REGULATORS

A. General Requirements: Single stage, steel jacketed, and corrosion resistant. Include elevation compensator.

B. Service-Pressure Regulators: ANSI Z21.80; 100-psig maximum inlet pressure. Factory- or field-installed, stainless-steel screen in vent opening if not connected to vent piping.

C. Line Pressure Regulators: ANSI Z21.80; 2-psig maximum inlet pressure. Factory- or field-installed, stainless-steel screen in vent opening if not connected to vent piping.
D. Appliance Pressure Regulators: ANSI Z21.18; 2-psig maximum inlet pressure. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING INSTALLATION

A. Comply with requirements in Section 230500 "Common Work Results for HVAC" for basic piping installation requirements.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade.
   1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Install shutoff valve, downstream from gas meter, outside building at gas service entrance.

E. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Comply with requirements in Section 230500 "Common Work Results for HVAC" for wall penetration systems.

F. Install pressure gage downstream from each service regulator. Pressure gages are specified in Section 230500 "Common Work Results for HVAC."

G. Install service meters to comply with gas company requirements.

H. All exterior gas piping to be painted with (1) coat primer and (2) coats yellow enamel.

I. Provide roof mount piping carriers equal to Miro "Pillow Blocks" of adequate quantity to maintain grade and support.

3.2 INDOOR PIPING INSTALLATION

A. Comply with requirements in Section 230500 "Common Work Results for HVAC" for basic piping installation requirements.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Piping Installed under Buildings: Install piping under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with a weatherproof vent cap.
D. Install escutcheons at penetrations of interior walls, ceilings, and floors.

E. 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 in Section 078413 "Penetration Firestopping."

F. Install service meters to comply with gas company requirements.

G. Install gas stops for shutoff to appliances with low-pressure gas supply.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

J. Connect branch piping from top or side of horizontal piping.

K. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

L. Install strainer on inlet of each line pressure regulator and automatic or electrically operated valve.

M. Install pressure gage downstream from each line regulator. Pressure gages are specified in Section 230500 "Common Work Results for HVAC."

N. Connect gas piping to equipment and appliances with shutoff valves and unions. Install gas valve upstream from and within 72 inches of each appliance using gas. Install union or flanged connections downstream from valves.

O. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to the outdoors and terminate with weatherproof vent cap.

P. Do not use natural-gas piping as grounding electrode.

Q. All gas appliances to be equipped with proper sized gas regulators vented to exterior.

3.3 PIPING JOINT CONSTRUCTION


B. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators.

C. Joints in Steel Piping with Protective Coating: Apply joint cover kits to pipe after joining to cover, seal, and protect joints.

E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions conforming to SAE J513. Tighten finger tight then using wrench. Do not overtighten.

G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.4 VALVE INSTALLATION
A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install anode for metallic valves in underground PE piping.

3.5 OUTDOOR PIPING SCHEDULE
A. Underground natural-gas piping shall be the following:
   1. PE pipe and fittings joined by heat-fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.

B. Aboveground natural-gas piping shall be the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.6 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG
A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
   1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
2. Annealed-temper copper tube with wrought-copper fittings and brazed joints.
3. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Drawn-temper copper tube with wrought-copper fittings and brazed joints.

C. Underground, below building, shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.7 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG (3.45 kPa) AND LESS THAN 5 PSIG (34.5 kPa)

A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:

1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
2. Annealed-temper copper tube with wrought-copper fittings and brazed joints.
3. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Drawn-temper copper tube with wrought-copper fittings and brazed joints.

C. Underground, below building, shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel with wrought-steel fittings and welded joints. Coat underground pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

END OF SECTION 231123
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 REQUIREMENTS


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.
   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.
   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.
   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.
   2. Type: S.
   3. Grade: NS.
   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:

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:

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:

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.
10. Flexible ducts.
11. Duct accessory hardware.

1.2 QUALITY ASSURANCE


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.
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.
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):
   2. Ruskin Company.
   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.

2.4 RADIATION DAMPER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 016000 – Product Requirements):
   2. Ruskin Company.
   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: Hinged door, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.


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.
   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 caulk.

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 COMBINATION 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):
2. Nailor Industries Inc.
3. Ruskin Company.
5. Potterff.

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.


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.

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.

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, "Vanels 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.


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. Ventfabs, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

   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. Ventfabs, 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.

   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).

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.

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.
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 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.
5. Titus.
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
PART 1 - GENERAL

1.1 GENERAL

A. Packaged air-to-air fixed-plate Energy Recovery Ventilator (ERV).

B. ERV must include the following components:
   1. Fixed-plate air-to-air energy recovery core
   2. Fresh air blower
   3. Exhaust air blower
   4. Filters ahead the core in both fresh and exhaust air circuits
   5. Cabinet for indoor installation
   6. Temperature gauge and controllers for an autonomous use

C. The ERV must be capable of transferring both sensible and latent energy.

D. The ERV must be designed to be used as a stand-alone unit or as a component in a dedicated HVAC system or as complete ventilation/HVAC unit.

E. The unit must be delivered fully assembled with gauge and controllers, ready to be plugged on the field.

F. ERV must include BacNet interface to building BMS system.

1.2 QUALITY ASSURANCE

A. The fixed-plate energy recovery core must be AHRI certified for the 1060 standard. Non-certified product will not be considered.


C. The unit must be ETL certified.

D. The insulation shall comply with NFPA 90A requirements for flame spread and smoke generation.

E. Unit must be free of fabrication defects and maintain proper operation under normal use for a period of two years from purchasing date.

F. Unit must be fully tested before delivery.

G. Unit shall be certified under UL 1812, Standard for Ducted Air to Air Heat Exchangers. Specific UL-1812 Listing Standards for outdoor units including rain testing, UV exposure testing, corrosion resistance and temperature extremes testing shall be
required for these models. Due to ongoing product offerings and upgrades, some models and options are not included in UL Listing reports.

H. The energy recovery ventilator will be warranted to be free from defects in material and workmanship for a period of two years from the purchase date. The energy recovery core will be warranted to be free from defects in material and workmanship for a period of ten years from the purchase date.

1.3 SUBMITTALS

A. Submit shop drawings, manufacturer's installation instructions, and product data under provisions of Division 1.

B. Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.

C. Product data shall indicate dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, gages, and finishes of materials.

D. Provide fan curves with specified operating point clearly plotted. Also plot operating point at 15 percent greater than the scheduled static pressure at the CFM listed.

E. Submit sound power levels for both fan outlet and casing radiation at rated capacity per ASHRAE Standard 52P.

F. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field installed wiring.

G. Submit manufacturer's sample copy of warranty.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 1.

B. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 1 in factory-fabricated protected containers, with factory-installed shipping skids and lifting lugs.

B. Store and protect products under provisions of Division 1.

C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish. Rotate fan shafts once per week while in storage.
1.6 ENVIRONMENTAL REGULATIONS
   A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.7 WARRANTY
   A. Provide manufacturer's warranty under provisions of Division 1.
   B. Provide two (2) year parts and labor warranty.
   C. Provide five (5) year warranty for compressors.
   D. The project must be substantial complete and fully commissioned with owner acceptance prior to the start of the warranty date.

PART 2 - PRODUCTS

2.1 ENERGY RECOVERY UNITS
   A. Manufacturer
      1. Conserv.

2.2 CABINET
   A. The cabinet must have a single-wall construction of 1" insulated with fiberglass insulation. The fiberglass insulation must be covered with an aluminum foil.
   B. External wall of the unit must be made of pre-painted steel, satin enamel paint finish, of gauge 22. The exterior wall of the unit must be made of prepainted galvanized steel 22 ga. The paint must be made of a silicone based polyurethane and withstand 150 rub (back and forth) with methyl ethyl ketone (MEK) when tested as per ASTM-D5402.
   C. The structural base of the unit must be made of 22 gauge pre-painted steel.
   D. Unit base must have lifting anchorage
   E. Internal components must be accessible from both sides using hinged panels.
   F. All components that need maintenance must be easily removed from the unit by either side.

2.3 FIXED PLATE ENERGY RECOVERY CORE
   A. The energy recovery section must be of the fixed-plate air-to-air type.
B. The energy recovery fixed-plated core must be made of a polymeric membrane to recover both sensible and latent heat. The core must avoid mold growth on it.

C. The fixed-plate air-to-air heat/energy recovery core must be easily cleanable.

D. The core efficiency must be rated as per AHRI-1060 and certified by AHRI.

E. Plate Type Energy Transfer Core shall be Standard Enthalpy (sensible and latent heat transfer).

2.4 FANS

A. The supply and exhaust fans must be motorized backward-inclined impeller.

B. The unit must have four fans, two on each air circuit.

C. Each air circuit must be air balanceable electronically. No choke or mechanical adjustment will be accepted.

2.5 VFD DRIVE MOTORS

A. Unit must be equipped with VFD drives for both supply and exhaust fans.

2.6 FILTERS

A. Filters must be MERV 8, 2" thick, unless specified in the project schedule.

B. Filters must be installed ahead of the energy recovery core in both the fresh and exhaust air circuits.

C. Filters must be easily cleaned.

2.7 ELECTRICAL REQUIREMENT

A. Unit must have a single-point electrical connection.

B. Electrical voltage must be 208V, 3-ph.

2.8 FROST CONTROL

A. Frost control must be made through an evacuation cycle.

B. Frost control evacuation cycle must be fully autonomous.

C. Frost control cycle must be field adjustable from standard to extended cycle.
2.9 UNIT CONTROL

A. Unit must be delivered with all the electrical and control components, pre-wired, for autonomous use.

B. Default speed must be field settable electronically (Off, low, medium and high).

C. Unit must have an optional reduced speed, field settable.

D. Unit must be capable of functioning without any external signal.

E. Unit must be capable of functioning in an elaborate building management system using dry contacts.
   1. Unit must be supplied with dry contacts (24VAC 20 Va) for:
      a. Occupancy control (Start/stop)
      b. Synchronization (NO and NC) with other HVAC unit
      c. Speed selection (Low speed and High speed)
   2. Unit must have auxiliary connection 24 VAC 10 Va to control independently:
      a. Supply air damper
      b. Exhaust air damper

F. Unit must be capable of functioning with wall controller:
   1. Humidity Control
   2. Digital Multifunction Wall Control
   3. 20/40/60 Minute Timer
   4. Speed Control
   5. Mode Control
   6. 7-Day Programmable Time

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Follow the equipment manufacturer’s instructions for handling and installation, and setting up of ductwork for makeup and exhaust air steamers for maximum efficiency.

D. Seal ductwork connections per the applicable related specification to avoid air leakage.
E. Contractor shall furnish and maintain and replace clean pre-filter media in each air handling unit as listed in the equipment schedule on the Drawings during start-up and construction. The Contractor shall install the tagged set of new filter products provided by the air handling unit manufacturer for each unit after it has been tested, commissioned and receives final acceptance by the Owner.

F. Provide all necessary control wiring as recommended by the manufacturer or the ERV.

G. Provide the correct condensate traps to compensate for blow or draw through pressure characteristics.

3.2 TESTING

A. Prior to an integrated test and Start-up of this unit, a factory-authorized field service representative is to perform the following:

1. Verify that the unit has specified filtration installed.
2. A full inspection of the assembled unit to confirm the correct rotation of motors.
3. To make seal and / or damper adjustments, test and adjust controls and interlocks.
4. Set and verify initial setpoints on controls and instruments.
5. Perform required final performance leakage test measurements and record for verification by to the Engineer prior to final approval and acceptance of the ERU.

END OF SECTION 237200
SECTION 237413 – AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes factory fabricated horizontal condensing type gas-fired furnace w/D-X refrigeration coil.

B. Applicable provisions of Sections “Basic Mechanical Requirements” and “Basic Mechanical Materials”, and respective complementary Sections, govern products and work of this Section.

C. Temperature 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.

D. Vibration Control is specified in Section 230548.

1.2 SUBMITTALS

A. Submit product data and shop drawings for each air handling unit to be installed on this Project. Drawings shall be for actual units proposed to be furnished for this Project, configured for respective installation, not generic typical drawings.

1. Include rated capacities of proposed unit(s) and furnished specialties and accessories, and efficiency rating.

2. All exceptions to specifications must be clearly defined. Contractor shall be responsible for all additional expenses that may occur due to exception(s) made.

B. Operation and Maintenance Manuals: Include maintenance data and parts list for each unit and accessory, along with product data and shop drawings.

1.3 QUALITY ASSURANCE

A. Manufacturer: Regularly engaged in production of respective type units; issue complete catalog, test, and rating data on total product offerings.

B. Construct units and certify ratings in compliance with following ARI Standards

C. UL Compliance: Provide electrical components which have been listed and labeled by UL.
1.4 DELIVERY, STORAGE, AND HANDLING
   A. Deliver units factory-assembled to the extent allowable by shipping limitations and building access, with protective crating and covering.
   B. Lift and support units with manufacturer’s designated lifting or supporting points.
   C. Disassemble and reassemble units as required for movement into final location, following manufacturer’s written instructions.

1.5 EXTRA MATERIALS
   A. Furnish extra and spare air filters for a total of (2) extra set.

PART 2 - PRODUCT

2.1 ACCEPTABLE MANUFACTURERS
   A. Acceptable Manufacturers: Subject to compliance with requirements.
      1. Carrier Corp.
      2. Trane.
   B. Reference Product(s): Scheduled or noted on Drawings.

2.2 AIR-HANDLING UNITS
   A. Furnish and install, horizontal/vertical condensing type gas fired furnace having capacities and efficiency as specified in schedule on plans. Furnaces shall have the following features.
      1. Sealed combustion (direct vent) system.
      2. Four-pass, heavy gauge aluminized steel heat exchanger with monoport inshot burners.
      3. Complete front service access.
      4. Multi-speed, direct drive, PSC blower motor with adjustable control.
      5. Electronic spark ignition.
      7. 20 year heat exchanger warranty.
      8. Plug style blower speed selector.
     10. Field fabrication plenum with filter rack.
PART 3 - EXECUTION

3.1 AIR-HANDLING UNITS

A. Install all air handling units where indicated. Installation shall comply with manufacturer’s instructions for clearances, arrangement, etc.

B. Patch all leaks found during pressure testing on air handling system.

C. Provide PVC concentric gas vent & combustion air piping package for wall penetration. Installation as per manufacturer’s recommendations.

END OF SECTION 237413
SECTION 237433 – CONDENSING UNITS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes factory fabricated and assembled air cooled air cooled condensing units.
B. Applicable provisions of Section “Common Work Results for HVAC”, and respective complementary Sections, govern products and work of this Section.
C. Temperature 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 SUBMITTALS
A. Submit product data and shop drawings for each unit to be installed on this Project. Drawings shall be for actual units proposed to be furnished for this Project, configured for respective installation, not generic typical drawings.
   1. Include rated capacities of proposed unit(s) and furnished specialties and accessories, and motor efficiency rating.
   2. All exceptions to specifications must be clearly defined. Contractor shall be responsible for all additional expenses that may occur due to exception(s) made.
B. Operation and Maintenance Manuals: Include maintenance data and parts list for each unit and accessory.

1.3 QUALITY ASSURANCE
A. Manufacturer: Regularly engaged in production of respective type units; issue complete catalog, test, and rating data on total product offerings.
B. Construct units and certify ratings in compliance with ARI Standards
C. UL Compliance: Provide electrical components which have been listed and labeled by UL.

1.4 DELIVERY, STORAGE, AND HANDLING
A. Deliver units factory-assembled to the extent allowable by shipping limitations and building access, with protective crating and covering.
B. Lift and support units with manufacturer’s designated lifting or supporting points.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements.
   1. Carrier
   2. Trane

2.2 AIR-COOLED CONDENSING UNITS

A. Furnish and install as specified an air-cooled condensing unit of size, efficiency, and capacity as specified herein and on plans. Unit shall contain sufficient refrigerant line fittings that permit mechanical or sweat connection. Brass service valves with fittings and gauge ports shall be located on exterior of unit.

B. Total net cooling capacity of the unit shall be BTUH coincident with 95 degree F dry-bulb temperature of air entering condenser.

C. Compressor shall be of the welded hermetic type with internal vibration isolation and be located in an isolated section of units.

D. Controls shall be factory wired and placed in a control readily accessible from side of unit. Compressor motor shall have both thermal and current sensitive overload devices.

E. Condenser coil shall be constructed with aluminum fins mechanically bonded to nonferrous tubing. Condenser fan shall be propeller type, direct driven, and arranged for vertical air discharge. Fan motor shall be factory lubricated, totally enclosed and inherently protected.

F. Accessories shall include Tubing Package, Start Capacitor and Relay, Indoor Fan Relay, Thermostat and Subbase, Low-Voltage Transformer, Liquid-Line Filter Drier and Sight Glass, Suction Line Connection Adapter, Liquid-Line Solenoid Valve, Anti-Short Cycle Timer and Head Pressure Control for Low Ambient Cooling to 0 F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Condensing units shall be installed and started in accordance with the manufacturer's instructions.

B. Provide 4" thick poured concrete equipment pads for units installed on grade.

END OF SECTION 237433
SECTION 238126 – DUCTLESS SPLIT-SYSTEM HEAT PUMP UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.2 SUBMITTALS

A. Product Data:
   1. Evaporator-fan components.
   2. Condensing unit components.
   3. Refrigeration piping line set.
   4. System controls.

B. Operation and maintenance data.

C. 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.

B. ASHRAE Compliance:
   1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."


1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
   1. Compressor: Five year(s) from date of Substantial Completion.
   2. Other Parts: One year(s) from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
   1. Carrier

2.2 INDOOR UNITS 5 TONS OR LESS

A. Concealed Evaporator-Fan Components:
   1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
   2. Insulation: Faced, glass-fiber duct liner.
   4. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
   5. Fan Motors:
      a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
      b. Multi-tapped, multispeed with internal thermal protection and permanent lubrication.
      c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
   7. Condensate Drain Pans:
      b. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
         1) Minimum Connection Size: NPS 1.
      c. Pan-Top Surface Coating: Asphaltic waterproofing compound.

B. Wall-Mounted, Evaporator-Fan Components:
   1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pan with drain connection.
   2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
   3. Fan: Direct drive, centrifugal.
   4. Fan Motors:
a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
b. Multi-tapped, multispeed with internal thermal protection and permanent lubrication.
c. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

5. Condensate Drain Pans:
   a. Drain pan width to extend across entire coil including headers and return bends.
   b. Drain Connection: Threaded nipple located at lowest point of pan. Provide with drain line to outdoors or as indicated on plan.

6. Air Filtration: factory standard washable filter.

2.3 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 inverter 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.


4. Fan: Aluminum-propeller type, directly connected to motor.

5. Motor: Permanently lubricated, with integral thermal-overload protection.


2.4 ACCESSORIES

A. Thermostat: Low-voltage, Remote Wired Controller.

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.
F. Condensing unit wall mounting brackets.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install units level and plumb.
B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
C. Install compressor-condenser components on angle iron frame securely attached to building wall.
D. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
E. Install interlock wiring between evaporator and compressor units.

3.2 CONNECTIONS
A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
C. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL
A. Perform tests and inspections.
1. **Manufacturer's Field Service**: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. **Tests and Inspections:**

1. **Leak Test**: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. **Operational Test**: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. **Test and adjust controls and safeties**: Replace damaged and malfunctioning controls and equipment.

C. **Remove and replace malfunctioning units and retest as specified above.**

D. **Prepare test and inspection reports.**

3.4 **DEMONSTRATION**

A. **Train Owner's maintenance personnel to adjust, operate, and maintain units.**
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cabinet unit heaters with centrifugal fans and electric-resistance heating coils.
2. Wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.2 PERFORMANCE REQUIREMENTS

A. Unit Heaters shall perform satisfactorily in the following service conditions:

1. Elevation: 7500 feet above sea level.
2. Maximum ambient temperature: 104 degrees F.
3. Minimum ambient temperature: Minus 20 degrees F.
4. 24-hour average temperature: not exceeding 86 degrees F.

B. Seismic Protection and Performance: The seismic protection and performance of Unit Heaters shall be in accordance with Section 22 0548, Vibration and Seismic Controls for Plumbing Piping and Equipment.

C. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a professional engineer licensed in the State of NM, using performance requirements and design criteria indicated.

1.3 SUBMITTALS

A. Product Data: For each type and size of unit heater indicated, include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated. Include documentation indicating that units comply with ASHRAE 62.1, Section 5 - Systems and Equipment.

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. Plans, elevations, sections, and details.
2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly
3. Location and size of each field connection.

4. Wiring Diagrams: Power, signal, and control wiring as applicable.

5. Equipment schedules to include rated capacities, furnished specialties, and accessories.

C. Manufacturer's Installation Instructions.

D. Unit Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

E. Test Reports: For each type of electric unit heater. Include factory test reports.

F. Operation and maintenance data: Include emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by any nationally recognized testing laboratory (NRTL) recognized under 29 CFR 1910.7.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - Systems and Equipment; and Section 7 - Construction and Startup.

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - Heating, Ventilating, and Air-Conditioning.

D. Gas-Fired Unit Heater Performance Requirements: Conform to minimum efficiency prescribed by ASHRAE 90.1 when tested in accordance with ANSI Z83.8.

1.5 WARRANTY

A. Furnish five year manufacturer warranty.

PART 2 - PRODUCTS

2.1 Manufacturers: Subject to compliance with requirements, provide products indicated on Drawings or a comparable product by one of the following:

A. QMark Electric Heating; a division of Marley Engineered Products.

2.2 CABINET UNIT HEATERS

A. Description: A factory-assembled and tested unit complying with AHRI 440, Performance Rating of Room Fan-Coils.
1. Comply with the safety requirements in UL 1995 and UL 2021 for heaters with electric heating coils.

B. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint.

1. Vertical Unit, Exposed Front Panels: Minimum [16 gage] [14 gage], galvanized, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.

2. Horizontal Unit, Exposed Bottom Panels: Minimum [16 gage] [14 gage], galvanized, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.

3. Control Access Door: Key operated.

4. Vertical Mounted Units:
   a. Base: Minimum 16 gage steel, finished to match cabinet, 6 inches high with leveling bolts.
   b. False Back: Minimum 18 gage thick steel, finished to match cabinet.

C. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in 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.

D. Fan and Motor:

1. Fan: Centrifugal; forward curved, double width, directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.


3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

E. Basic Unit Controls:

1. Control voltage transformer.

2. Unit-mounted thermostat with the following features.
   b. Fan on-auto switch.

F. Electrical Connection: Factory wire motors and controls for a single field connection.
G. Capacities and Characteristics: See drawings.

2.3 WALL AND CEILING ELECTRIC UNIT HEATERS

A. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

B. Cabinet:
   1. Front Panel: [Stamped-steel louver] [Extruded-aluminum bar grille], with removable panels fastened with tamperproof fasteners.
   2. Finish: Baked enamel over baked-on primer with manufacturer's color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
   3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.


E. Fan: Aluminum propeller directly connected to motor.

F. Controls: Unit-mounted thermostat (tamperproof for locations where heater is used for freeze protection only). Low-voltage relay with transformer kit.

G. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.


PART 3 - EXECUTION

3.1 INSTALLATION

A. Install unit heaters to comply with NFPA 90A.
B. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

C. Install piping adjacent to machine to allow service and maintenance.

D. Connect piping to unit heater’s factory, hot-water piping package. Install the piping package if shipped loose.

E. Ground equipment according to Section 26 0526, Grounding and Bonding for Electrical Systems.

F. Connect wiring according to Section 26 0519, Low-Voltage Electrical Power Conductors and Cables.

G. Adjust initial temperature set points.

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and prepare test reports:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. For units that have electric resistance heating coils, operate electric heating elements through each stage to verify proper operation and electrical connections.
   3. 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 238239
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:
   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:
   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.

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 Crawlsspaces: Type THHN-THWN, single conductors in raceway.

C. Feeders and Branch Circuits Concealed in Ceilings, Walls, Partitions, and Crawlsspaces: 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.


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:
   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 260519 – LOW-VOLTAGE ELECTRICAL 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


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.


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.


S. UL 486C - Splicing Wire Connectors; 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


D. Alcan; Model Stabiloy: www.cable.alcan.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.

2.4 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
   1. Copper Building Wire:
      d. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Aluminum Building Wire (only where specifically indicated or permitted for substitution):
      d. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
   1. Feeders and Branch Circuits:
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:
   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:
   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.

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.

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.
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.
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.

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.
   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.
   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 260553.

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

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
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 AWS 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 NEC 1 and NEC 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.


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.

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.


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:
   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. Minimum 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.


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.


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.


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.


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. 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 metal 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 Homers: 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.
   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:
   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.
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, grommets, 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.
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.
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

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.
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:
   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:
      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.
   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.
   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.
   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.
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.

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.
   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:
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
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 260534.

C. Wires, Cables, and Connectors. Provide wires, cables, and connectors complying with Division 260519 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 torquing 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.

      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.

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.

E. 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.
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.

K. UL 67 - Panelboards; 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
   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:

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.

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”.

DISCONNECT SWITCHES
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.


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.


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.
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. Calculated footcandle plot using appropriate software program, on reasonable grid, for all interior & exterior spaces.

PART 2 - PRODUCTS

2.1 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.

2.2 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.

2.3 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.

2.4 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:
   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
B. NFPA 70 - National Electrical Code; 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. 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.

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](http://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:
   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.

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.

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.
   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.
   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 resets fuse 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 onboard 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:


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 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Utility Locator Service: Notify the Indiana One-Call system for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.

E. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect remaining trees and shrubs from damage and maintain vegetation. Employ a licensed arborist to repair tree and shrub damage. Restore damaged vegetation. Replace damaged trees that cannot be restored to full growth, as determined by arborist.

D. Do not store materials or equipment or permit excavation within drip line of remaining trees.

E. Protect site improvements to remain from damage. Restore damaged improvements to condition existing before start of site clearing.

F. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to project drawings.
G. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
   1. Arrange with utility companies to shut off indicated utilities.

3.2 SITE CLEARING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.
   1. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
   2. Chip brush, branches, and trees and dispose of off-site.

B. Strip topsoil. Remove sod and grass before stripping topsoil. Stockpile topsoil that will be reused in the Work.
   1. Stockpile surplus topsoil to allow for re-spreading deeper topsoil.

C. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

D. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Neatly saw-cut length of existing pavement to remain before removing existing pavement.

E. Dispose of waste materials, including trash, debris, and excess topsoil, off Owner's property. Burning waste materials on-site is not permitted.
   1. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 311000
SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Unauthorized excavation consists of excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

B. Utility Locator Service: Notify Indiana One-Call system for area where Project is located before beginning earth moving operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, or other deleterious matter.


C. Backfill and Fill: Satisfactory soil materials.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Protect and maintain erosion and sedimentation controls during earth moving operations.

B. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

C. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

D. Explosives: Do not use explosives.

E. Excavate to subgrade elevations regardless of character of materials and obstructions encountered.
F. Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Engineer. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents.

G. Excavate for structures, building slabs, pavements, and walkways. Trim subgrades to required lines and grades.

H. Utility Trenches: Excavate trenches to indicated slopes, lines, depths, and invert elevations.

1. Place, compact, and shape bedding course to provide continuous support for pipes and conduits over rock and other unyielding bearing surfaces and to fill unauthorized excavations.

I. Grade areas to a smooth surface to cross sections, lines, and elevations indicated. Grade lawns, walkways, and unpaved subgrades to tolerances of plus or minus 1 inch and pavements and areas within building lines to plus or minus 1/2 inch (13 mm).

J. Under pavements and walkways, place subbase course material on prepared subgrades and compact at optimum moisture content to required grades, lines, cross sections, and thicknesses.

K. Under slabs-on-grade, place drainage course on prepared subgrade and compact to required cross section and thickness.

L. Allow testing agency to inspect and test each subgrade and each fill or backfill layer and verify compliance with requirements.

M. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000
SECTION 312200 – GRADING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Removal of topsoil.
B. Rough grading the site for site structures and building pads.
C. Finish grading.

1.2 RELATED SECTIONS

A. Section 31 1000 - Site Clearing.
B. Section 31 2316 - Excavation.
C. Section 31 2323 - Fill: Filling and compaction.
D. Section 32 9219 - Seeding: Finish ground cover.
E. Section 32 9300 - Plants: Topsoil in beds and pits.

1.3 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.4 PROJECT CONDITIONS

A. Protect above- and below-grade utilities that remain.
B. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.
C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from grading equipment and vehicular traffic.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Topsoil excavated on-site.
1. Graded.
2. Free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds and foreign matter.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify that survey bench mark and intended elevations for the Work are as indicated.

3.2 PREPARATION
   A. Identify required lines, levels, contours, and datum.
   B. Stake and flag locations of known utilities.
   C. Locate, identify, and protect utilities that remain, from damage.
   D. Notify utility company to remove and relocate utilities.

3.3 ROUGH GRADING
   A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
   B. Do not remove topsoil when wet.
   C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
   D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.
   E. When excavating through roots, perform work by hand and cut roots with sharp axe.
   F. See Section 31 2323 for filling procedures.
   G. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.
   H. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

3.4 SOIL REMOVAL
   A. Stockpile topsoil to be re-used on site; remove remainder from site.
   B. Stockpile subsoil to be re-used on site; remove remainder from site.
C. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet; protect from erosion.

3.5 FINISH GRADING

A. Before Finish Grading:
   1. Verify building and trench backfilling have been inspected.
   2. Verify subgrade has been contoured and compacted.

B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove soil contaminated with petroleum products.

C. Where topsoil is to be placed, scarify surface to depth of 3 inches.

D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches.

E. Place topsoil in areas where seeding are indicated.

F. Place topsoil where required to level finish grade.

G. Place topsoil to the following compacted thicknesses:
   1. Areas to be Seeded with Grass: 6 inches.
   2. Shrub Beds: 18 inches.
   3. Flower Beds: 12 inches.

H. Place topsoil during dry weather.

I. Remove roots, weeds, rocks, and foreign material while spreading.

J. Near plants spread topsoil manually to prevent damage.

K. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.

L. Lightly compact placed topsoil.

3.6 TOLERANCES

A. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

B. Top Surface of Finish Grade: Plus or minus 1/2 inch.

3.7 CLEANING AND PROTECTION

A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.
B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION 312200
SECTION 312316 – EXCAVATION

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. Excavation for buildings and other structural foundations.
   2. Excavation for roads and walkways.
   3. Excavation for site structures and utilities.

C. Related Sections:
   1. Division 01 Section "General Requirements."
   2. Division 31 Section "Site Clearing".
   3. Division 31 Section "Backfilling".

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.

B. 29CFR - OSHA Construction Standards:
   1. Part 1926 - Safety and Health Regulations for Construction – Subpart P - Excavations

1.3 SUBMITTALS

A. Submit under provisions of Division 01 Section "General Requirements."
B. Shop Drawings: Submit a construction drainage plan showing the collection and disposal of surface and subsurface water that may be encountered in the course of construction.

C. Shoring Plan: Before excavating 5 feet or more in depth, submit a shoring plan in accordance with the requirements in Division 01 Section “General Requirements.”

1.4 PROJECT CONDITIONS

1.5 Verify that survey benchmark and intended elevations for the Work are as indicated

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

A. Underpin adjacent structures and roads which may be damaged by excavation work, including utilities and pipe chases.

B. Identify required lines, levels, contours, and datum.

C. Prior to penetrating any ground surface, obtain "Permit to Penetrate or Excavate Surfaces at LBNL" in accordance with Division 01 Section "Environmental, Safety, and Health Procedures". Forty eight hours notice is normally required from when a permit is requested to when it is issued; the Subcontractor is responsible for scheduling the permit request to suit construction activities. Identify known underground, above ground, and aerial utilities. Stake and flag locations.

D. Coordinate utility relocation or removal with the Project Manager.

E. Protect above and below grade utilities which are to remain. Support exposed utilities as needed.

F. Protect plant life, lawns, and other site features indicated to remain.

G. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.

3.2 EXCAVATION

A. Excavate subsoil required to accommodate building foundations, slabs-on-grade, paving, utilities and site structures, construction operations. The maximum slope inclinations shall comply with OSHA.

B. Excavate to working elevation for piling or caisson work.
C. Machine slope banks to angle of repose or less, unless shored in accordance with the references cited in Divisions 01 Sections "General Requirements" and "Environmental, Safety, and Health Procedures".

D. Excavation cut not to interfere with normal 45 degree bearing splay of foundations.

E. Grade top perimeter of excavation to prevent surface water from draining into excavation.

F. Hand trim excavation as needed. Remove loose matter.

G. Remove lumped subsoil, boulders, and rock.

H. Notify the Project Manager promptly in writing of unexpected subsurface conditions before such conditions are disturbed and stop affected work in area until notified to resume work.

I. Correct unauthorized excavation at no extra cost to the University.

J. Correct areas over-excavated by error with lean concrete with a minimum 28 day compressive strength of 1,500 psi or in accordance with Division 31 Section "Backfilling".

K. Stockpile excavated material in area designated on site and remove excess material not being reused, from site. Cover stockpiled material to protect from rain. Take preventive measures to ensure that water containing soil from excavations or stockpiles does not enter storm drains.

3.3 FIELD QUALITY CONTROL

A. Field inspection will be performed under provisions of Division 01 Section "Special Provisions."

3.4 PROTECTION

A. Protect excavations by underpinning, sloping or shoring, as required to ensure life safety and protect property. Comply with applicable laws and standards.

B. Protect the bottom of excavations and soil within the 45° degree bearing splay of existing foundations.
SECTION 312316.13 – TRENCHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes trenching provisions to govern respective portions of Division 23 work.

B. Additional and other requirements, methods, and procedures for trenching required for particular systems are included in respective Sections. Specific requirements in respective specifications have precedence over general requirements in this Section.

1.2 REFERENCES

A. Following documents form a part of this specification to the extent indicated herein:

   b. D2487 Classification of Soils for Engineering Purposes.
   c. D2922 Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).

1.3 PROJECT/SITE CONDITIONS

A. Do not place frozen materials and do not place materials on a frozen or muddy surface.

PART 2 - PRODUCTS

2.1 BEDDING SAND

A. No. 24, Class B sand in accordance with INDOTSS 903, certificate required.

2.2 UNDERGROUND PIPING IDENTIFICATION TAPE

A. Tape: Polyethylene, 4 mil minimum thick, 3 inches wide with repeated black imprint, “CAUTION - (name of service)”, a different distinctive fade resistant color for each service.

B. Reference Products

1. W.H. Brady, “Identoline”.
2. EMEDCO, “Underground Warning Tape”.
PART 3 - EXECUTION

3.1 WORK

A. All trenching to be performed by the respective Contractor providing the installed materials.

3.2 EXAMINATION

A. Before commencing work; verify requirements for, and coordinate operations with, the following:

1. Installation of fences, including protective fencing for trees and plants.
2. Demolition of miscellaneous structures.
3. Clearing and grubbing.
4. Stripping and disposal of sod, and stripping and stockpiling of topsoil.

3.3 PREPARATION

A. Locate and mark all existing underground installations (utilities, etc.) in the area of operations.

B. Lay out the various lines on the ground using stakes and flags. Coordinate locations with existing underground installations and other work of this Division and other Divisions. Do not proceed with excavating until layout is approved.

C. Set line and grade stakes as required or specified in respective piping System Sections.

3.4 PROTECTION

A. Shore and brace excavations as necessary to prevent cave-ins.

B. Protection of Subgrade and Embankment.
1. During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade in such manner as to drain effectively at all times.
2. Operate pumping equipment as required to keep excavation free of water and subgrades dry, firm, and undisturbed until permanent work has been approved by Architect.
3. Storage or stockpiling of materials on finished subgrade will not be permitted.
4. Erosion Control: Provide and perform erosion control as specified in Division 1 Section “Temporary Facilities” until permanent vegetation, structures and erosion control devices have been installed.
C. Protection of Topsoil Areas: After placement of topsoil, protect these areas from heavy machinery. Topsoil compacted by heavy machinery shall be removed and replaced at no additional cost to Owner.

3.5 TRENCHING

A. Trenching in General.

1. Perform excavating of every description, and of whatever substances are encountered, to depths indicated or required.

2. Excavation: By open cut, unless indicated otherwise, except short sections of a trench may be tunneled if pipe can be safely and properly installed and backfill can be properly compacted in tunnel sections.

3. Sheeting and Shoring: Placed as necessary for protection of work and safety of personnel.

4. Material Suitable for Backfill: During excavating, pile in an orderly manner a sufficient distance from banks of trench to avoid overloading and to prevent slides or cave-ins.

5. To prevent surface water from flowing into trenches or other excavations, perform grading as necessary.

6. Water Accumulating in Excavations: Remove by pumping or other acceptable methods.

7. Excavated Materials Not Required or Suitable for Backfill: Removed as waste materials.

B. Trench excavation.

1. Trench Width: As necessary for proper laying of pipe.
   a. Width of Trenches at All Points Below Top of Pipes: Not be greater than outside diameter of pipe plus 24 inches, nor less than outside diameter of pipe plus 12 inches, to permit satisfactory jointing and thorough tamping of bedding material under and around pipe.
   b. Sheeting and Bracing: Where required, place within specified trench width.
   c. Where Trench Widths are Exceeded: Provide stronger pipe or special installation procedures as directed without additional cost to Owner.

2. Banks of Pipe Trenches: As nearly vertical as practicable.

3. Bottom of Trenches: Accurately graded to provide a uniform surface for bedding at a depth not less than 1/3 the diameter of the pipe, 4 inches minimum, below bottom perimeter of pipe. Provide recesses in trench bottom to accommodate bells, joints, couplings, etc.

4. Stones: Remove as necessary to avoid point bearing.

5. Take care to not over excavate.
   a. Except as specified for overexcavation due to wet, rocky or otherwise unstable material; backfill overdepths as specified for backfilling lower portion of trenches.
b. Wet or otherwise unstable material in bottom of trench that is incapable of properly supporting pipe shall be overexcavated to a depth to allow for construction of a stable pipe bedding.

c. When overexcavation is performed, backfill with a suitable material, compacted to a minimum of 4 inches below bottom and 4 inches on each side of pipe.

3.6 PAVEMENT REMOVAL AND REPLACEMENT

A. Remove and replace sidewalks, drives, etc. where required, as a part of respective mechanical installation work. Replace removed paving to match existing, and meet City specifications.

B. Pavement removal and replacement are governed by Division 1 Section “Cutting and Patching”.

3.7 BEDDING

A. Deposit bedding sand in 6-inch maximum thickness layers in bottom of trench and compact to specified density with suitable tampers up to gradient of bottom of pipe.

B. As pipe is placed on bedding, deposit additional bedding sand on both sides of pipe and compact up to a layer thickness equal to 1/3 the diameter of pipe.

3.8 DISPOSITION OF WASTE MATERIALS

A. Remove waste materials from site and dispose of in a lawful manner.

END OF SECTION 312316.13
SECTION 312323 – BACKFILLING

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. Building perimeter and site structure backfilling.
   2. Site filling and backfilling.
   3. Fill under slabs-on-grade and/or paving.
   4. Consolidation and compaction.
   5. Fill for over-excavation.

C. Related Sections:
   1. Division 01 Section "General Requirements."
   2. Division 01 Section "Special Procedures."
   3. Division 03 Section "Cast-in-Place Concrete."
   4. Division 31 Section "Excavation".
   5. Division 31 Section "Trenching".

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.

B. ASTM International:
   1. ASTM C136  Method for Sieve Analysis of Fine and Coarse Aggregates
   2. ASTM D2992  Test Method for Density of Soil in Place by Nuclear Methods
   3. ASTM D1557  Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³(2,700 kN-m/m³))
1.3 SUBMITTALS

A. Submit under provisions of Division 01 Section "General Requirements."

B. Submit a certified mix design and aggregate sieve analysis conforming with ASTM C136 for controlled density fill, if used.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

A. Type A - Coarse Stone, Crushed Rock or Gravel: Free of shale, clay, friable material, sand, debris; graded in accordance with the Engineer’s recommendations and a cleanliness value of 75 or greater.

B. Type B - Class 2, Aggregate Base: Free of vegetable matter and other deleterious substances, and shall be of such nature that it can be compacted readily using water, tamping and rolling to form a firm, stable base.

C. Type C - Pea Gravel: Washed, free of clay, shale, organic matter; graded in accordance with the Engineer's recommendations and have a cleanliness value of 75 or greater.

D. Type D - Sand: Natural river or bank sand; or washed sand free of silt, clay, loam, friable or soluble materials, or organic matter; graded in accordance with ASTM C136 and having a sand equivalent of 75.

E. Type E - Imported Backfill: Nonexpansive soil, free of debris, organic material and clods or rocks larger than 4 inches with a liquid limit no greater than 40 and a plasticity index no greater than 15.

F. Type F - Native Backfill: “As is”, free of debris, organic material and clods or rocks larger than 4 inches.

G. Water: Free of objectionable quantities of silt, oil, organic matter, alkali, or salts.

H. Controlled Density Fill: Controlled density fill will be considered an acceptable alternative to Type E or F backfill at the Subcontractor’s option.

2.2 CONTROLLED DENSITY FILL

A. Controlled Density Fill Mix: Consisting of portland cement, fly ash, water, fine and course aggregate and an air entraining admixture. The proportions of the controlled density fill shall conform to the mix design. Controlled density fill shall have a 28 day unconfined compressive strength from a minimum of 50 psi to a maximum of 150 psi.
B. Aggregates that produce the performance characteristics of the control density fill may be submitted for approval. The maximum size aggregate is 3/8-inch; the quantity of aggregate material passing a #200 sieve shall not exceed 12 percent.

C. Air Content: Not to exceed 6 percent when measured in conformance with ASTM C231.

2.3 ACCESSORIES

A. Geotextile Fabric: Mirafi, Exxon, or equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Control dust throughout backfill operations.

B. Compact subgrade to density requirements for subsequent backfill materials. Cut out soft areas of subgrade not capable of in situ compaction. Backfill with the type of material indicated on the Drawings and compact to density equal to or greater than requirements for subsequent backfill material.

C. Prior to placement of aggregate base course material at paved areas, compact subsoil to 95 percent of its maximum dry density at optimum water content –1 percent + 3 percent in accordance with ASTM D1557 to the depth as indicated on the Drawings, but not less than 6 inch.

3.2 BACKFILLING

A. Backfill areas to contours and elevations with specified materials.

B. Systematically backfill by mechanical means. Do not backfill over porous, wet, or spongy subgrade surfaces.

C. Place geotextile fabric as shown on the drawings.

D. Type A, C or D Fill: Place and compact materials in continuous layers not exceeding 6 inch compacted depth.

E. Type B Fill - Aggregate Base Class 2: Placement of aggregate base shall not proceed until the Subcontractor has obtained the Owner approval for compaction and grading of the subbase.

F. Type E or F Fill: Place and compact material in continuous layers not exceeding 6 inch compacted depth under structures, roads or site structures, and eight inches compacted depth in other areas.
G. Employ a placement method that does not disturb or damage foundation perimeter drainage or foundation waterproofing.

H. Maintain moisture content of backfill materials within –1 percent to +3 percent of optimum to attain required compaction density.

I. Slope grade away from building minimum two inches in 10 ft, unless noted otherwise.

J. Make grade changes gradual. Blend slope into level areas.

K. Remove surplus excavated materials from site.

L. Leave fill material stockpile areas completely free of excess fill materials.

3.3 TOLERANCES

A. Top Surface of Backfilling Under Paved Areas: The surface of the finished aggregate base at any point shall not vary more than 1/2-inch above or below the grade shown on the Drawings.

3.4 PROTECTION OF FINISHED WORK

A. Protect finished work.

B. Recompact fills subjected to vehicular traffic.

3.5 SCHEDULE (unless otherwise noted on the Drawings)

A. One foot wide layer on exterior side of foundation walls, and behind retaining walls and over foundation perimeter drainage.
   1. Filter fabric and Type A fill to subgrade elevation, compacted in six-inch lifts with each lift compacted to 95 percent.

B. Below unpaved areas on exterior side of foundation walls, and behind retaining walls and over foundation perimeter drainage.
   1. Type E or F fill to subgrade elevation compacted in six inch lifts with each lift compacted to 90%.

C. Fill Under Grass Areas:
   1. Type E or F fill, to 6 inch below finish grade, compacted in six inch lifts with each lift compacted to 90 percent.

D. Fill Under Landscaped Areas:
   1. Type E or F fill, to 12 inches below finish grade, compacted in six inch lifts with each lift compacted to 90%.
E. Fill Under Asphalt or Concrete Paving:

1. Type B fill, to subgrade elevation, compacted in six inch maximum lifts with each lift compacted to 95 percent.

END OF SECTION 312323
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. Crawlsspaces: 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.
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.
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 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and hot-mix asphalt design mixes.

PART 2 - PRODUCTS

2.1 ASPHALT PAVING

A. Regulatory Requirements: Comply with requirements of INDOT for asphalt paving work.

B. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

2.2 MATERIALS

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction.

1. Base Course: #9 385#/SYD.
2. Surface Course: #11 165#/SYD.
3. Provide mixes with a history of satisfactory performance in geographical area where Project is located and complying with ASTM D 3515 for the following nominal, maximum aggregate sizes:
   a. Base Course: 3-1/2 inch.
   b. Surface Course: 1-1/2 inch.

B. Tack Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

C. Pavement-Marking Paint: MPI #32 alkyd traffic marking paint.


D. Pavement-Marking Paint: MPI #97 latex traffic marking paint.


E. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.
PART 3 - EXECUTION

3.1 PAVING

A. Tack coat existing asphalt or concrete surfaces and allow tack coat to cure undisturbed.

B. Place hot-mix asphalt to required grade, cross section, and thickness. Promptly correct surface irregularities in paving course.
   
   1. Spread mix at minimum temperature of 250 deg F.

C. Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers. Complete compaction before mix temperature cools to 185 deg F.

D. Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness.

E. Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to 92 percent of reference maximum theoretical density according to ASTM D 2041.

F. Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

G. While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

H. Remove and restore paved areas that are defective or contaminated.

I. Allow paving to age for 30 days before starting pavement marking.

J. Apply pavement-marking paint with mechanical equipment to a minimum wet film thickness of 15 mils.

K. Install wheel stops in bed of adhesive as recommended by manufacturer.

L. Securely attach wheel stops into pavement with two galvanized-steel dowels.
SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS
A. Submittals: Product Data and design mixtures for concrete.
B. Comply with ACI 301, "Specification for Structural Concrete."

PART 2 - PRODUCTS

2.1 MATERIALS
A. Welded Wire Reinforcement: ASTM A 185, flat sheets.
B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
C. Fly Ash: ASTM C 618, Type C or F.
E. Chemical Admixtures: ASTM C 494. Calcium chloride shall not be used.
F. Synthetic Fiber: ASTM C 1116, Type III, polypropylene fibers, 1/2 to 1-1/2 inches.
G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
I. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable and resistant to lime and other alkalis.
J. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery.

2.2 CONCRETE MIXTURES
A. Proportion normal-weight concrete mixes to provide the following properties:
   1. Compressive Strength: 4000 psi at 28 days.
   2. Slump Limit: 4 inches, plus or minus 1 inch, at point of placement.
   3. W/C Ratio: 0.45 maximum at point of placement.
4. Air Content: 5-1/2 percent plus or minus 1.5 percent.

PART 3 - EXECUTION

3.1 PAVING

A. Accurately position and support reinforcement, and secure against displacement.

B. Locate and install contraction, construction, isolation, and expansion joints as indicated or required.

C. Place concrete in a continuous operation within planned joints or sections. Do not add water to adjust slump.

D. Float surfaces to true planes within a tolerance of 1/4 inch in 10 feet and medium-to-fine-textured broom medium-to-coarse-textured broom finish.

E. Tool edges and joints to a radius of 1/4 inch.

F. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on pavement surface according to manufacturer’s written instructions.

G. Begin curing after finishing concrete. Keep concrete continuously moist for at least seven days.

H. Apply traffic paint with mechanical equipment to a minimum wet film thickness of 15 mils.

I. Owner will employ a testing agency to sample concrete, perform tests, and submit test reports during concrete placement.

J. Remove and replace concrete paving that is broken, damaged, or defective. Exclude traffic from paving for at least 14 days.

END OF SECTION 321313
SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 FENCE COMPONENTS

A. Fabric: Metallic-coated steel, 2-inch mesh, .120-inch diameter wire.

B. Posts and Rails: Galvanized-steel pipe complying with ASTM F 1043 requirements for heavy industrial fence.

C. Tension Wire: Metallic-coated steel, ASTM A 817 and ASTM A 824.

D. Fittings and Accessories: ASTM F 626, color coated to match fabric, and as follows:
   1. Post and Line Caps: Provide weathertight cap for each post. Provide line post caps with loop to receive tension wire or top rail.
   2. Post Brace Assembly: Same material as top rail with 3/8-inch-diameter rod and adjustable tightener.
   3. Bottom and Center Rail: Same material as top rail with cap on each end.

E. Gate Posts, Swing Gates, and Accessories: ASTM F 900, same metal and finish as posts and rails, with galvanized hardware and accessories.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fence to comply with ASTM F 567.

B. Excavation: Drill post holes 8 inches in diameter and 40 inches in depth, equally spaced, but not more than 10 feet apart.

C. Setting Posts: Set posts in holes approximately 4 inches above bottom of excavation. Align posts vertically and align tops. Pour concrete footings with tops 2 inches above grade, troweled to a crown to shed water.

END OF SECTION 323113
SECTION 323119 - DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and color Samples.

PART 2 - PRODUCTS

2.1 DECORATIVE METALLIC-COATED STEEL TUBULAR PICKET FENCES & GATES

A. Ametco, Falcon Design Aluminum Picket Fence, with staggered top.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fences by setting posts as indicated and fastening rails and infill panels to posts. Peen threads of bolts after assembly to prevent removal.

B. Post Excavation: Excavate holes to a diameter of not less than four times post size and a depth of not less than 36 inches plus 3 inches for each foot or fraction of a foot that fence height exceeds 4 feet.

C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Posts Set in Concrete: Extend post to within 6 inches of specified excavation depth, but not closer than 3 inches to bottom of concrete.

D. Install gates level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Adjust hardware for smooth operation and lubricate where necessary.

END OF SECTION 323119
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

    1. Seeding.
    2. Sodding.

B. Related Sections:

    1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
    2. Section 312000 "Earth Moving" for excavation, filling and backfilling, and rough grading.

1.3 DEFINITIONS

A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

I. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 INFORMATIONAL SUBMITTALS

A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

B. Product Certificates: For fertilizers, from manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk fertilizers, and soil amendments with appropriate certificates.
1.6 PROJECT CONDITIONS

A. Planting Restrictions: Plant during the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.

1. Summer Planting: 7/28 – 8/15. (Sodding along Indianapolis Avenue improvements and Clark Hall lateral.)
2. Fall Planting: 10/1 – 11/28. (Seeding remaining disturbed areas. Note that all lawn areas that have been disturbed by 10/20 must be seeded by 10/31.)

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.7 MAINTENANCE SERVICE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:

1. Seeded Turf: 60 days from date of planting completion.
   a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.
2. Sodded Turf: 30 days from date of planting completion.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

2.2 TURFGRASS SOD

A. Turfgrass Sod: Certified, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.
2.3 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 16 percent nitrogen, 28 percent phosphorous, and 12 percent potassium, by weight.

2.4 PLANTING SOILS

A. Planting Soil: Existing, in-place surface soil. Verify suitability of existing surface soil to produce viable planting soil. Remove stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.

B. Planting Soil: Imported topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from bogs or marshes.

1. Additional Properties of Imported Topsoil or Manufactured Topsoil: Screened and free of stones 1 inch or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth; free of obnoxious weeds and invasive plants including quackgrass, Johnsongrass, poison ivy, nutedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass; not infested with nematodes, grubs, other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled, pore-space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.

2.5 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.

2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.

3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.

4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

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

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydro-seeding and hydro-mulching overspray.

2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. Limit turf subgrade preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

   a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.

   b. Reduce elevation of planting soil to allow for soil thickness of sod.
C. **Unchanged Subgrades:** If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:

1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 6 inches of soil. Till soil to a homogeneous mixture of fine texture.
3. Remove stones larger than 1 inches in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

D. **Finish Grading:** Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus ½ inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

E. Moistened prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 **SEEDING**

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.
2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of 10 lb/1000 sq. ft.

C. Sow fertilizer at a total rate of 150 lb/1 acre.

D. Rake seed & fertilizer lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

E. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.

F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 4 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
3.5 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across angle of slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.6 TURF RENOVATION

A. Renovate existing turf.

B. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish turf where settlement or washouts occur or where minor re-grading is required.
2. Install new planting soil as required.

C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

D. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

E. Mow, dethatch, core aerate, and rake existing turf.

F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

I. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.

J. Apply seed and protect with straw mulch as required for new turf.

K. Water newly planted areas and keep moist until new turf is established.

3.7 TURF MAINTENANCE

A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, re-grade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.

2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.

3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

3.8 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.
3.9 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

C. Remove non-degradable erosion-control measures after grass establishment period.

END OF SECTION 329200
SECTION 329201 – EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Contractor shall furnish all materials, equipment and labor to provide all temporary erosion and sediment control as described on the plans for this project. This includes control of erosion and sediment along channels, side ditches and around inlets and manholes.

B. The Contractor shall provide for a complete, comprehensive Storm Water Pollution Prevention Plan, along with the appropriate SWCD Rule 5 approvals and NOI & NOT submittals to the Indiana Department of Environmental Management. The Contractor shall maintain all documentation & logs on site at all times.

1.2 PRODUCT HANDLING

A. Store and protect miscellaneous erosion control items at the Project site as required by the manufacturer.

1.3 SUBMITTALS

A. Submit shop drawings indicating all shop and installation details as recommended by the manufacturer.

B. Include all performance data such as temporary seed mixtures, strengths for geotextile sediment filters, silt fence, silt fence posts, and other material specifications normally available and provided from the manufacturer.

1.4 RELATED SPECIFICATIONS

A. All work shall comply with the requirements set forth in Rule 327 IAC-15-1 and 327 IAC-1 5-5 and any and all subsequent additions and revisions.

1.5 POTENTIAL POLLUTANT SOURCES

A. During construction of the water main, there are several pollutant sources that could potentially enter the stormwater systems in the area (i.e., creeks, storm sewers, drainage swales, etc.)

B. The following is a list of such items and precautions the Contractor shall take to prevent the pollutants from entering the existing stormwater facilities in the area:
1. Sediment: The Contractor shall follow the guidelines in this specification to prevent sediment from entering any storm sewer, drainage swale or creek bed.
2. Gasoline/Grease/Oil: The Contractor shall regularly inspect all vehicles and equipment in use on the project.
3. Trash/Debris: The Contractor shall keep all construction areas free of trash and debris which could leave the site and enter a storm sewer, drainage swale or creek bed. This shall include keeping the trash and debris out of the open trenches.

PART 2 - PRODUCTS

2.1 GENERAL

A. All products shall be in accordance with the INDOTSS. Silt fence and silt fence filters are preferred in lieu of straw bales. All inlets in turfed areas shall incorporate sediment filters below the casting grate. Shop drawings shall be submitted for all items covered in this specification.

PART 3 - EXECUTION

3.1 STORMWATER QUALITY MEASURE IMPLEMENTATION SEQUENCE

A. Before beginning construction in an area, the Contractor shall review the plans and mark and protect trees and their associated root zones, along with any other designated areas noted on the drawings.

B. The Contractor shall take all necessary precautions to protect the existing septic tanks and their absorption fields with temporary fencing to prohibit accidental soil disturbing activities.

C. Before clearing and grading, the Contractor shall install sediment basins or traps where necessary to capture sediment-laden runoff from the construction-disturbed areas.

D. Also before clearing and grubbing, the Contractor shall install a main runoff conveyance system with inlet and outlet protection devices to avoid the natural creation of gullies and to prevent damage to the receiving waters.

E. Once erosion and sediment control measures are in place, the Contractor shall begin land clearing and trench excavation, followed immediately by rough grading when sewer trench is closed. The Contractor shall not leave large areas unprotected for more than 7-days.

F. As rough grading is done, the Contractor shall install additional traps, silt fences, slope drains, temporary diversions, and other runoff control measures as needed at appropriate locations to keep sediment contained on-site.
G. Immediately after rough and/or final grading, the Contractor shall apply surface stabilization practices on all graded areas in accordance with the erosion/sediment control plan. If weather delays permanent stabilization, temporary seeding and/or mulching may be necessary as a stop-gap measure. Also stabilize (using temporary seeding/mulching or other suitable means) any disturbed area where active construction will not take place for 15 working days.

H. Erosion control blankets are to be installed immediately after any stream or drainage swale crossing. Due to the high potential for erosion, the work is to be completed within 48 hours of the start of the crossing. In order to meet this requirement, all materials for erosion control are to be located at the site of the crossing prior to initializing the crossing. Backfilling the open cut is to be completed as soon as the pipe has been installed and is not to wait until the entire line has been completed. An erosion control blanket shall be installed immediately after backfilling the open cut. The erosion control blanket shall be installed per manufacturer's requirements.

I. After construction and final grading are complete, the Contractor shall landscape and/or permanently stabilize all disturbed sites, including borrow and disposal areas. All temporary runoff control structures and any unstable sediment around them shall be removed and the areas shall be vegetated as needed.

3.2 INSTALLATION AND MAINTENANCE

A. All erosion and sediment control items shall be installed in strict conformance with the manufacturer's instructions. Said instructions shall be included with the shop drawings.

B. Prior to construction of the site, erosion control measures shall be installed to control erosion and prevent sediment laden water from exiting the site. This shall include, but not be limited to, the installations of temporary earthen berms, silt fences, filter curtains, riprap, drainage piping, catch basins, and other items that are needed to control sediment.

C. The project area shall be inspected no less than once per week and after every 1/2" rainfall event and shall be maintained for erosion control measures during construction. Both temporary and final seeding is required. Should any areas outside of the basin remain inactive for a period of 15 days or more, they shall be seeded with a temporary vegetative cover such as oats, wheat or rye.

D. Silt fences shall be installed by the Contractor to retain sediment from disturbed areas. Fence shall approximately follow the contour of the land and shall be located at least ten (10) feet from the toe of slope to provide broad, shallow sediment pool. Access to the area shall be provided for sediment clean-out. 2x2-inch hardwood posts (or steel fence posts) with a maximum of eight (8) foot spacing shall be used. Support wire (if needed) shall be 14-gauge, six (6) inch mesh wire fence. Fence fabric shall be either woven or non-woven, geotextile fabric with minimum 85% filtering efficiency. The fence fabric shall contain UV inhibitors and stabilizers to insure six (6) month minimum life at temperatures between 0-120°F. The fence shall be installed per the manufacturer's recommendations to insure acceptable performance. When work is completed with an acceptable ground cover, the silt fence may be removed.
E. The Contractor shall also prevent any wind-borne soil particles, which could create a health and/or visibility hazard from leaving the disposal sites. The Contractor shall apply and approved dust preventative, as necessary, to avoid and eliminate a health and/or visibility hazard due to wind-borne particles. The dust preventative must be approved by the Owner prior to use.

F. Construction operations shall be carried out in such a manner and sequence that erosion and air and water pollution shall be minimized and held within acceptable limits. It is important that material excavated from this project be contained.

G. Construction entrance shall be installed in a location to be determined by the Owner. The entrances shall be inspected weekly and cleaned and reshaped as needed for drainage and runoff control. The entrances shall be redressed with clean stone as needed.

H. The construction entrances shall be a minimum of 50-feet in length and 10-feet in width. The entrance shall consist of a compacted subgrade; followed by 6-inches of #2 Crushed Stone, compacted and choked with 10FF; followed by 4-inches of #53 Crushed Stone, compacted.

I. The Contractor shall immediately remove mud and sediment tracked or washed onto public roads by brushing or sweeping. Any roads which experience broken pavement due to these construction activities shall be repaired immediately at the Contractors expense. This shall apply to all roads in the project area which are immediately adjacent to construction activities.

J. The following Erosion Control Schedule shall be used for this project:

1. Stone Entrance
   a. Maintenance: Minimum of 1 entrance shall be provided per site
   b. Installation Sequence: Prior to clearing and grading

2. Silt Fence
   a. Maintenance: Weekly, after storm events and as necessary
   b. Installation Sequence: Prior to clearing and grading

3. Existing Inlet/Drain Pipe Protection
   a. Maintenance: Weekly, after storm events and as necessary
   b. Installation Sequence: Prior to clearing and grading

4. Tree Protection
   a. Maintenance: Weekly, after storm events and as necessary
   b. Installation Sequence: Along with rough grading

5. Temporary Seeding
   a. Maintenance: Water as needed
b. Installation Sequence: After rough grading and/or within 15 days of inactivity

6. Permanent Seeding
   a. Maintenance: Water as needed
   b. Installation Sequence: After finish grading and/or within 15 days of inactivity

7. Erosion Control Matting
   a. Maintenance: Weekly, after storm events and as necessary
   b. Installation Sequence: After finish grading

8. Inlet Protection
   a. Maintenance: Weekly, after storm events and as necessary
   b. Installation Sequence: After each inlet is placed

9. Seed, Sod, and Landscape Around Inlets
   a. Maintenance: Water as needed
   b. Installation Sequence: After finish grading around finished inlets

10. Removal of Inlet Protection
    a. Installation Sequence: After all areas draining to these area are stabilized

11. Removal of Silt Fence
    a. Installation Sequence: After all areas draining to these area are stabilized

K. The Contractor shall be responsible to keep an inspection log for weekly inspections and after every 1/2” rainfall event, up to the time that 70% of the permanent cover has been established. At a minimum the record shall include name of the Contractor's Inspector, location of the inspection, date of the inspection, the date and amount of the last rainfall, and description of any findings. A copy of the log shall be available on-site for review by the Engineer.

L. The Contractor shall be required to have both temporary and permanent seeding completed within 15-days of inactivity. In addition, the Contractor shall be required to place 70% cover on temporary and permanent seedings.

3.3 TESTING

A. All materials provided under this Specification shall meet the requirements of the Indiana Stormwater Quality Manual and all of the applicable sections of the Indiana Department of Transportation Standards Specifications (INDOTSS), latest edition. Certification of such compliance shall be provided with the cost for such testing the Contractor's responsibility.
3.4 POST CONSTRUCTION REQUIREMENTS

A. Implementation

1. All post-construction stormwater quality measures (i.e., rip rap, drainage swales, permanent seeding, etc.) shall be installed as soon as feasibly possible.
2. The Contractor shall take care to remove all left-over construction equipment and materials completely from the project site to prevent material, debris, etc. from entering the stormwater facilities.

B. Post Construction Stormwater Quality Measures

1. Prior to leaving the site, the Contractor shall thoroughly clean all sediment, dust, debris, etc. from all roads which experienced heavy construction traffic throughout the project.
2. Rip rap or erosion control blankets shall be installed at all creek crossings as indicated in the contract drawings. The rip rap or erosion control blankets shall be installed at the time the crossing is completed. Prior to project completion, the Contractor shall restore the rip rap, if used, to the original condition at the time of installation.

END OF SECTION 329201
SECTION 329202 – RESTORATION OF SURFACES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Restoration of surfaces shall include the removal of the existing surface, the disposal of the surplus material and the construction of new surfaces and adjusting all new and existing structures for proper grade prior to paving as indicated on the plans and/or as specified in these Specifications.

1.2 RESTORATION OF PAVED SURFACES

A. Restoration

1. After all excavations within the limits of paved surfaces have been properly backfilled, compacted and repaired, the paved surfaces shall be restored to a condition as good as or better than existed prior to the beginning of the work, in accordance with the following specifications.

2. State Paved Surfaces: Highways, streets and roads constructed and/or maintained by the Indiana Department of Transportation (INDOT), which are wholly or partially removed, damaged or disturbed by the Contractor's operations shall be restored to a condition as good as or better than existed prior to the beginning of the work. Such restoration shall be performed in accordance with the pertinent specifications and standards of the Indiana Department of Transportation, as applicable.

3. Other Paved Surfaces: Streets, alleys, sidewalks, driveways, curbs and gutters, not constructed or maintained by the Indiana Department of Transportation, but paved with asphalt, concrete, cinders, crushed stone, waterbound macadam, oil-bound macadam, or heterogenous paving materials, which are wholly or partially removed, damaged, or disturbed by the Contractor's operations, shall be restored with like or better materials, acceptable to the Engineer, to a condition as good as or better than existed prior to the beginning of the work, so that movement of traffic, both vehicular and pedestrian, through the restored way shall be as free, safe and unimpeded as before.

B. Temporary Surface

1. Temporary trench surfaces shall be installed and maintained in accordance with this specification. This temporary surface shall be maintained by the Contractor until the permanent pavement is placed. Before placing permanent pavement, all or parts of the temporary surface shall be removed, as necessary, and hauled from the site of the work.
PART 2 - PRODUCTS

2.1 TEMPORARY PAVEMENT REPLACEMENT

A. Trench surfaces of highly traveled streets and roads may be designated to receive a temporary pavement replacement of cold mixed bituminous pavement. This temporary pavement shall be of the thickness specified or shown on the plans and shall be surface mixture Class A or B prepared and placed in accordance with Section 403 - Cold Mixed Asphalt, CMA, Pavement of the latest edition of the INDOT Standard Specifications. Prime and tack coats shall not be required. All temporary pavement shall be maintained by the Contractor to proper grade so as not to impede the safe flow of traffic until the permanent pavement replacement is made.

2.2 PERMANENT PAVING

A. Permanent paved surfaces shall be restored in accordance with "Roadways and Parking Areas" and the following requirements, unless otherwise set forth in the plans, the Special Provisions or Detailed Specifications; however, in all cases, the methods and materials of restoration shall meet the requirements of the INDOT, as applicable.

2.3 RESTORATION OF GROUND SURFACES

A. All ground surfaces in public Rights-of-Way, easements and on private property that have been damaged or destroyed by the Contractor's operations shall be restored in accordance with the following specifications. All surplus material, rock, trees, shrubs, concrete pipe, asphalt, crushed stone, etc., not to be used in the Contractor's restoration operations shall be removed from the site and disposed of in an acceptable manner. All work, either sodding or seeding and mulching, shall be in accordance with WM-24, "Seeding and Sodding".

2.5 CLEAN UP

A. Before final acceptance of the work, the Contractor shall satisfactorily clean all areas within the limits of his operations including the street surfaces, walks, gutters, fences, lawns, private property and structures, leaving them in as neat, clean and usable condition as originally found. He shall remove all machinery, tools, surplus materials, temporary buildings and other structures from the site of work. He shall also remove all organic matter and materials containing organic matter from all areas and places used by him during construction. All pipes, manholes, inlets, etc., shall be cleared of all scaffolding, sedimentation, debris, rubbish and dirt.

B. Where the Contractor's operations have resulted in filling existing ditches, clogging existing culverts, damaging existing bridges, ground surfaces, sidewalks, driveways, etc., the Contractor shall re-ditch, clean culverts, repair or replace bridges, ground surfaces, sidewalks, driveways, etc. so as to return them to a condition as good as or better than existed prior to the beginning of his operations.
C. The Contractor's cleanup operations, which include repair, restoration or replacement of ground surfaces and existing improvements and the removal of rock, shall be performed continuously during the construction operations.

D. All cleanup and restoration shall be done to the approval of Linton Stockton School Corporation.