PROJECT MANUAL FOR

1501 Creekwood Parkway – Fitout Space for New WCH Ambulance Base

MU PROJECT NUMBER: CP200101
PWA 201918

AT: UNIVERSITY OF MISSOURI - COLUMBIA, MISSOURI

FOR: THE CURATORS OF THE UNIVERSITY OF MISSOURI

PREPARED BY:

PWARCHITECTS, INC.
ATTN: ERIC ROSELLE, AIA
2120 FORUM BOULEVARD, SUITE 101
COLUMBIA, MISSOURI 65203
PHONE: (573) 449-2683
FAX: (573) 442-6213

February 27, 2020

ISSUED FOR: BID
ARCHITECT:

I hereby certify these Drawings and/or Specifications have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Drawings and/or Specifications are as required by and in compliance with Building Codes of the University of Missouri.

The below listed Drawings and/or Specification sections have been prepared by me, or under my supervision. Any Specification sections within this document, not listed below, are not certified under this statement and are the responsibility of other parties.

Signature:_____________________________________
Eric S. Roselle – MO License No.: #A-2014036992

Certified Drawings:                  Certified Specification Sections:

G001  COVER SHEET                    01 2200  Unit Prices
G002  LOCATION MAP, LIST OF DRAWINGS,
      LEGENDS                          02 4100  Demolition
G101  LIFE SAFETY CODE               04 2000  Unit Masonry
AD100 DEMOLITION: FLOOR PLAN         05 5100  Metal Stairs
AD200 DEMOLITION: ELEVATIONS         05 5213  Pipe and Tube Railings
A101  FLOOR PLANS & DETAILS          06 1000  Rough Carpentry
A102  ENLARGED PLANS & DETAILS       06 4100  Architectural Wood Casework
A110  REFLECTED CEILING PLANS & DETAILS  07 2119  Foamed-in-Place Insulation
A300  BUILDINGS SECTION & DETAILS    07 6200  Sheet Metal Flashing and Trim
A301  BUILDINGS SECTION & DETAILS    07 8400  Firestopping
A401  INTERIOR ELEVATIONS & CABINET DETAILS  07 9200  Joint Sealants
A501  WALL PARTITIONS TYPES; DETAILS  08 1213  Hollow Metal Frames
A601  FINISH SCHEDULE & LEGEND; DOOR & WINDOW SCHEDULES & ELEVATIONS  08 1416  Flush Wood Doors
A602  DOOR & WINDOW DETAILS          08 3100  Access Doors and Panels
                                            08 5113  Aluminum Windows
                                            08 7100  Door Hardware
                                            08 7100.01  Door Hardware Schedule
                                            08 8700  Architectural Window Films
                                            09 0561  Common Work Results for Flooring Preparation

1501 Creekwood Parkway -              MU CP200101 / PWA 201918
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CIVIL ENGINEER:

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Signature: ____________________________

Andrew T. Greene – MO License No. PE-2020000043

Certified Drawings: Certified Specification Sections:

CE1 DEMOLITION, EROSION CONTROL & GRADING PLAN
     - Site Clearing
     - Earth Moving
CE2 UTILITY PLAN
     - Erosion Control
CE3 SITE PLAN
     - Asphalt Paving
CE4 SITE CONSTRUCTION DETAILS
     - Concrete Paving
     - Concrete Paving Joint Sealant
     - Pavement Markings
     - Turf and Grasses
     - Facility Water Distribution Piping
STRUCTURAL ENGINEER:

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Signature: ________________________________

Gregory L. Linneman, PE-2005001013

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MECHANICAL, PLUMBING, FIRE PROTECTION ENGINEER:

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Signature: [Signature]

Randy J. Diemer – MO License No.: #PE-2017015702

02/21/2020

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ELECTRICAL, FIRE ALARM ENGINEER:

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Signature: ___________________________
Monica Santoyo Santos – MO License No.: #E-2000174546

Certified Drawings:

E001 GENERAL NOTES AND SYMBOLS
E010 ELECTRICAL DEMOLITION
E201 LIGHTING PLANS
E301 POWER PLANS
E601 ELECTRICAL DETAILS
E701 SCHEDULES AND RISER DIAGRAMS

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Low-Voltage Electrical Power
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26 0526 Grounding and Bonding for Electrical
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Study
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Fitout space for New WCH Ambulance Base
Project CP200101
1501 Creekwood Parkway
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<td>26 0923</td>
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<td>26 2416</td>
<td>Panelboards</td>
<td>1-10</td>
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ADVERTISEMENT FOR BIDS

Sealed bids for:

1501 CREEKWOOD PARKWAY – 
FITOUT SPACE FOR NEW WCH AMBULANCE BASE 
UNIVERSITY OF MISSOURI 
COLUMBIA, MISSOURI
PROJECT NUMBER: CP200101 CONSTRUCTION ESTIMATE $490,915 - $545,461

will be received by the Curators of the University of Missouri, Owner, at Campus Facilities, Planning, Design & Construction, Room L100 (Front Reception Desk), General Services Building, University of Missouri, Columbia, Missouri 65211, until 1:30 p.m., C.T., March 26, 2020 and then immediately opened and publicly read aloud.

Drawings, specifications, and other related contract information may be obtained at http://operations-webapps.missouri.edu/pdc/adsite/ad.html. Electronic bid sets are available at no cost and may be printed as desired by the plan holders. No paper copies will be issued. If paper copies are desired, it is the responsibility of the user to print the files or have them printed.

Questions regarding the scope of work should be directed to Eric Roselle with PWArchitects at (573)449-2683 or eroselle@pwarchitects.com. Questions regarding commercial conditions should be directed to Jeff Fleenor at (573) 882-7356 or fleenorj@missouri.edu.

A prebid meeting will be held at 1:30 p.m., C.T., March 12, 2020 in the General Services Bldg., Rm 131, University of Missouri, Columbia, Missouri, followed by a walk-through at the site. All interested bidders are invited to attend this meeting. A walk-through of the project may be scheduled by contacting the Prebid Inspection Guide at (573) 882-2228 or mucfpmprebidsinspectionguides@missouri.edu. A 24 – 48 hour advance notice is required for all walk-through request.

Information regarding bid results will be available the day following the bid opening by calling (573) 882-1133.

A Diversity Participation goal of 10% MBE / 10% Combined WBE, DBE and Veteran Owned Business and 3% SDVE has been established for this contract.

The Owner reserves the right to waive informalities in bids and to reject any and all bids.

Individuals with special needs as addressed by the Americans with Disabilities Act may contact (573) 882-1133.

Advertisement Date: February 27, 2020

Gary L. Ward
Vice Chancellor for Operations and Chief Operating Officer
University of Missouri
SECTION 1.A

BID FOR LUMP SUM CONTRACT

Date:____________________________________

BID OF
(hereinafter called "Bidder") a corporation* organized and existing under laws of the State of _________________________
a partnership* consisting of _______________________
an individual* trading as _______________________
a joint venture* consisting of _______________________

*Insert Corporation(s), partnership or individual, as applicable.

TO: Curators of the University of Missouri

1. Bidder, in compliance with invitation for bids for construction work in accordance with Drawings and Specifications prepared by PWArchitects, Inc., entitled “1501 Creekwood Parkway – Fitout Space for New WCH Ambulance Base”, project number CP200101, dated February 27, 2020, having examined Contract Documents and site of proposed work, and being familiar with all conditions pertaining to construction of proposed project, including availability of materials and labor, hereby proposes to furnish all labor, materials and supplies to construct project in accordance with Contract Documents, within time set forth herein at prices stated below. Prices shall cover all expenses, including taxes not covered by the University of Missouri’s tax exemption status, incurred in performing work required under Contract documents, of which this Bid is a part.

Bidder acknowledges receipt of following addenda:

Addendum No. ___________________ Dated ________________
Addendum No. ___________________ Dated ________________
Addendum No. ___________________ Dated ________________
Addendum No. ___________________ Dated ________________

2. In following Bid(s), amount(s) shall be written in both words and figures. In case of discrepancy between words and figures, words shall govern.

3. BID PRICING
   a. Base Bid:

   The Bidder agrees to furnish all labor, materials, tools, and equipment required to renovate Owner-leased, tenant space to provide two ambulance bays and associated living quarters for on-call ambulance staff. The living quarters will include four (4) sleeping rooms, a common kitchen and lounge area, and two (2) private bathrooms; all as indicated on the Drawings and described in these Specifications for sum of:

   ________________________________ DOLLARS ($__________________).

   b. Unit Prices:

   (1) For changing specified quantities of work from those indicated by Contract Drawings and Specifications, upon written instructions of Owner, the following Unit Prices
shall prevail in accordance with General Conditions.

(2) The following Unit Prices include all labor, overhead and profit, materials, equipment, appliances, bailing, shoring, shoring removal, etc., to cover all work.

(3) The following Unit Prices are required where applicable to particular Base Bid and/or Alternate being submitted.

(4) Only a single Unit Price shall be given and it shall apply for either MORE or LESS work than that indicated on Drawings and called for in Specifications as indicated to be included in Base Bid and/or Alternates. In the event that more or less units than so indicated is actually furnished, Change Orders will be issued for increased or decreased amounts as approved by the Owner.

(5) Bidder understands that the Owner will not be liable for any Unit Price or any amount in excess of Base Bid and any Alternate(s) accepted at time of award of Contract, except as expressed in written Change Orders duly executed and delivered by Owner's Representative.

(6) Alternate Flooring Adhesive; Section 09 0561 Common Work Results for Flooring Preparation.

Base Bid quantity = 2025 s.f. $ /s.f.

(7) Remedial Floor Coating; Section 09 0561 Common Work Results for Flooring Preparation

Base Bid quantity = 2025 s.f. $ /s.f.

4. PROJECT COMPLETION

a. Contract Period - Contract period begins on the day the Contractor receives unsigned Contract, Performance Bond, Payment Bond, and "Instructions for Execution of Contract, Bonds, and Insurance Certificates." Bidder agrees to complete project within One-Hundred Fifty-Three (153) calendar days from receipt of aforementioned documents. Fifteen (15) calendar days have been allocated in construction schedule for receiving aforementioned documents from Bidder.

b. Commencement - Contractor agrees to commence work on this project after the "Notice to Proceed" is issued by the Owner. "Notice to Proceed" will be issued within seven (7) calendar days after Owner receives properly prepared and executed Contract documents listed in paragraph 4.a. above.

c. Refer to Special Scheduling Requirements in Special Conditions for specific scheduling of the following activities:
   1. Special work times
   2. Exhaust System work
   3. Incidental Floor Work (work in other occupied spaces for utility tie-ins)
   4. HVAC Testing and Balancing
   5. Utility Shut-downs, Outages and Tie-ins
   6. Refuse / Trash Removal and Materials Delivery

5. SUBCONTRACTOR LIST:

Bidder hereby certifies that the following subcontractors will be used in performance of Work:
NOTE: Failure to list subcontractors for each category of work identified on this form or listing more than one subcontractor for any category of work without designating the portion of work performed by each shall be grounds for rejection of bid. List name, city, and state of designated subcontractor, for each category of work listed in Bid For Lump Sum Contract. If work within a category will be performed by more than one subcontractor, Bidder shall provide name, city, and state of each subcontractor and specify exact portion of work to be performed by each. If acceptance/non-acceptance of Alternates will affect designation of a subcontractor, Bidder shall provide information, for each affected category, with this bid form. If Bidder intends to perform any designated subcontract work by using Bidder's own employees, then Bidder shall list their own name, city, and state. The bidder may petition the Owner to change a listed subcontractor only within 48 hours of the bid opening. See Information For Bidders Section 16 List of Subcontractors for requirements.

<table>
<thead>
<tr>
<th>Work to be performed</th>
<th>Subcontractor Name</th>
<th>City, State</th>
</tr>
</thead>
</table>

FM/UL Certified Fire Stopping Contractor

Mechanical

Electrical

Plumbing

Fire Protection Sprinkler Contractor

6. SUPPLIER DIVERSITY GOALS

20. The Contractor shall have as a goal subcontracting with Minority Business Enterprise (MBE) of TEN PERCENT (10%) and Women Business Enterprise (WBE), Disadvantage Business Enterprise (DBE), Service Disabled Veteran Owned Business and/or Veteran Owned Business of TEN PERCENT (10%) of awarded contract price for work to be performed.

b. Requests for waiver of this goal shall be submitted on the attached Application For Waiver form. A determination by the Director of Facilities Planning & Development, UM, that a good faith effort has not been made by Contractor to achieve above stated goal may result in rejection of bid.
c. The Undersigned proposes to perform work with following MBE/WBE participation level:

MBE PERCENTAGE PARTICIPATION: _______ percent (_______ %)

WBE, DBE, SERVICE DISABLED VETERAN, and/or VETERAN PERCENTAGE PARTICIPATION: _______ percent (_______ %)

d. A Supplier Diversity Compliance Evaluation form shall be submitted with this bid for each diverse subcontractor to be used on this project.

7. BIDDER'S ACKNOWLEDGMENTS

a. Bidder declares that he has had an opportunity to examine the site of the work and he has examined Contract Documents therefore; that he has carefully prepared his bid upon the basis thereof; that he has carefully examined and checked bid, materials, equipment and labor required thereunder, cost thereof, and his figures therefore. Bidder hereby states that amount, or amounts, set forth in bid is, or are, correct and that no mistake or error has occurred in bid or in Bidder's computations upon which this bid is based. Bidder agrees that he will make no claim for reformation, modifications, revisions or correction of bid after scheduled closing time for receipt of bids.

b. Bidder agrees that bid shall not be withdrawn for a period of Ninety (90) days after scheduled closing time for receipt of bids.

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

d. Accompanying the bid is a bid bond, or a certified check, or an irrevocable letter of credit, or a cashier's check payable without condition to "The Curators of the University of Missouri" which is an amount at least equal to five percent (5%) of amount of largest possible total bid herein submitted, including consideration of Alternates.

e. Accompanying the bid is a Bidder's Statement of Qualifications. Failure of Bidder to submit the Bidder's Statement of Qualifications with the bid may cause the bid to be rejected. Owner does not maintain Bidder's Statements of Qualifications on file.

f. It is understood and agreed that bid security of two (2) lowest and responsive Bidders will be retained until Contract has been executed and an acceptable Performance Bond and Payment Bond has been furnished. It is understood and agreed that if the bid is accepted and the undersigned fails to execute the Contract and furnish acceptable Performance/Payment Bond as required by Contract Documents, accompanying bid security will be realized upon or retained by Owner. Otherwise, the bid security will be returned to the undersigned.

8. BIDDER'S CERTIFICATE

Bidder hereby certifies:

a. His bid is genuine and is not made in interest of or on behalf of any undisclosed person, firm or corporation, and is not submitted in conformity with any agreement or rules of any group, association or corporation.

b. He has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid.

c. He has not solicited or induced any person, firm or corporation to refrain from bidding.
d. He has not sought by collusion or otherwise to obtain for himself any advantage over any other Bidder or over Owner.

e. He will not discriminate against any employee or applicant for employment because of race, color, religion, sex or national origin in connection with performance of work.

f. By virtue of policy of the Board of Curators, and by virtue of statutory authority, a preference will be given to materials, products, supplies, provisions and all other articles produced, manufactured, mined or grown within the State of Missouri. By virtue of policy of the Board of Curators, preference will also be given to all Missouri firms, corporations, or individuals, all as more fully set forth in "Information For Bidders."

9. BIDDER'S SIGNATURE

Note: All signatures shall be original; not copies, photocopies, stamped, etc.

<table>
<thead>
<tr>
<th>Authorized Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printed Name</td>
<td>Title</td>
</tr>
<tr>
<td>Company Name</td>
<td></td>
</tr>
<tr>
<td>Mailing Address</td>
<td></td>
</tr>
<tr>
<td>City, State, Zip</td>
<td></td>
</tr>
<tr>
<td>Phone No.</td>
<td>Federal Employer ID No.</td>
</tr>
<tr>
<td>Fax No.</td>
<td>E-Mail Address</td>
</tr>
</tbody>
</table>

Circle one: Individual          Partnership          Corporation          Joint Venture

If a corporation, incorporated under the laws of the State of__________

Licensed to do business in the State of Missouri? _____yes _____no

(Each Bidder shall complete bid form by manually signing on the proper signature line above and supplying required information called for in connection with the signature. Information is necessary for proper preparation of the Contract, Performance Bond and Payment Bond. Each Bidder shall supply information called for in accompanying "Bidder's Statement of Qualifications.")

END OF SECTION
UNIVERSITY OF MISSOURI
BIDDER'S STATEMENT OF QUALIFICATIONS

Submit with Bid for Lump Sum Contract in separate envelope appropriately labeled. Attach additional sheet if necessary.

1. Company Name___________________________________________________________
   Phone# __________________ Fax #: ____________________________
   Address __________________________________________________________________

2. Number of years in business _____. If not under present firm name, list previous firm names and types of organization.
   _________________________________________________________________________

3. List contracts on hand (complete the following schedule, include telephone number).

<table>
<thead>
<tr>
<th>Project &amp; Address</th>
<th>Owner/Owner's Representative</th>
<th>Phone Number</th>
<th>Architect</th>
<th>Amount of your Contract</th>
<th>Percent Completed</th>
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4. General character of work performed by your company personnel.
   _________________________________________________________________________

5. List important projects completed in the last five (5) years on a type similar to the work now bid for, including approximate cost and telephone number.

<table>
<thead>
<tr>
<th>Project &amp; Address</th>
<th>Owner/Owner's Representative</th>
<th>Phone Number</th>
<th>Architect</th>
<th>Amount of your Contract</th>
<th>Percent Completed</th>
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6. Other experience qualifying you for the work now bid.
   _________________________________________________________________________

7. No default has been made in any contract complete or incomplete except as noted below:
   (a) Number of contracts on which default was made _______________________
   (b) Description of defaulted contracts and reason therefor__________________
   _________________________________________________________________________

8. (a) Have you or your company participated in any contract subject to an equal opportunity clause similar to that described in the General Conditions?
    Yes _____ No _____
   (b) Have you filed all required compliance reports?
    Yes _____ No _____

BSQ/1 9/2016 Revision
(c) Is fifty percent or more of your company owned by a minority?
   Yes ______  No ______

(d) Is fifty percent or more of your company owned by a woman?
   Yes ______  No ______

(e) Is fifty percent or more of your company owned by a service disabled veteran?
   Yes ______  No ______

(f) Is fifty percent or more of your company owned by a veteran?
   Yes ______  No ______

(g) Is your company a Disadvantaged Business Enterprise?
   Yes ______  No ______

9. Have you or your company been suspended or debarred from working at any University of Missouri campus?
   Yes ______  No ______ (If the answer is "yes", give details.)

10. Have any administrative or legal proceedings been started against you or your company alleging violation of any wage and hour regulations or laws?
    Yes ______  No ______ (If the answer is "yes", give details.)

11. Workers Compensation Experience Modification Rates (last 3 yrs): ______/_____/_____
    Incidence Rates (last 3 years): ______/_____/_____

12. List banking references.

13. (a) Do you have a current confidential financial statement on file with Owner?
    Yes ______  No ______ (If not, and if desired, Bidder may submit such statement with bid, in a separate sealed and labeled envelope.)

(b) If not, upon request will you file a detailed confidential financial statement within three (3) days?
    Yes ______  No ______

Dated at ___________________________ this ___________ day of ______________________ 20____

Name of Organization

_____________________________________
Signature

_____________________________________
Printed Name

_____________________________________
Title of Person Signing

END OF SECTION
SUPPLIER DIVERSITY COMPLIANCE EVALUATION FORM

This form shall be completed by Bidders and submitted with the Bidder's Statement of Qualifications form for each diverse firm who will function as a subcontractor on the contract.

The undersigned submits the following data with respect to this firm's assurance to meet the goal for Supplier Diversity participation.

I. Project:  

II. Name of General Contractor: ________________________________  

III. Name of Diverse Firm: ________________________________  

   Address: ________________________________  

   Phone No.: ________________________________  

   Fax No.: ________________________________  

   Status (check one) MBE _____ WBE _____ Veteran_____ Service Disabled Veteran______ DBE______  

IV. Describe the subcontract work to be performed. (List Base Bid work and any Alternate work separately):  

   Base Bid: __________________________________  

   __________________________________  

   __________________________________  

   __________________________________  

V. Dollar amount of contract to be subcontracted to the Diverse firm:  

   Base Bid: __________________________________  

   Alternate(s), (Identify separately): __________________________________  

   __________________________________  

   __________________________________  

   __________________________________  

VI. Is the proposed subcontractor listed in the Directory of M/W/DBE Vendors, Directory of Serviced Disabled Veterans and/or the Directory of Veterans maintained by the State of Missouri?  

   Yes _____  

   No _____
Is the proposed subcontractor certified as a diverse supplier by any of the following: federal government agencies, state agencies, State of Missouri city or county government agencies, Minority and/or WBE certifying agencies?

Yes ______  No ______  If yes, please provide details and attach a copy of the certification.

__________________________________________________________________

__________________________________________________________________

__________________________________________________________________

Does the proposed subcontractor have a signed document from their attorney certifying the Supplier as a Diverse and meeting the 51% owned and committed requirement?

Yes ______  No ______  If yes, please attach letter.

Signature: __________________________________________________________

Name: ____________________________________________________________

Title: _____________________________________________________________

Date: _____________________________________________________________
This form shall be completed and submitted with the Bidder's Statement of Qualifications. Firms wishing to be considered for award are required to demonstrate that a good faith effort has been made to include diverse suppliers. This form will be used to evaluate the extent to which a good faith effort has been made. The undersigned submits the following data with respect to the firm's efforts to meet the goal for Supplier Diversity Participation.

1. List pre-bid conferences your firm attended where Supplier Diversity requirements were discussed.

2. Identify advertising efforts undertaken by your firm which were intended to recruit potential diverse subcontractors for various aspects of this project. Provide names of newspapers, dates of advertisements and copies of ads that were run.

3. Note specific efforts to contact in writing those diverse suppliers capable of and likely to participate as subcontractors for this project.

4. Describe steps taken by your firm to divide work into areas in which diverse suppliers/contractors would be capable of performing.

5. What efforts were taken to negotiate with prospective diverse suppliers/contractors for specific sub-bids? Include the names, addresses, and telephone numbers of diverse suppliers/contractors contacted, a description of the information given to diverse suppliers/contractors regarding plans and specifications for the assigned work, and a statement as to why additional agreements were not made with diverse suppliers/contractors.

6. List reasons for rejecting a diverse supplier/contractor which has been contacted.
8. Describe the follow-up contacts with diverse suppliers/contractors made by your firm after the initial solicitation.


9. Describe the efforts made by your firm to provide interested diverse suppliers/contractors with sufficiently detailed information about the plans, specifications and requirements of the contract.


10. Describe your firm's efforts to locate diverse suppliers/contractors.


Based on the above stated good faith efforts made to include supplier diversity, the bidder hereby requests that the original supplier diversity percentage goal be waived and that the percentage goal for this project be set at ________ percent.

The undersigned hereby certifies, having read the answers contained in the foregoing Application for Waiver, that they are true and correct to the best of his/her knowledge, information and belief.

Signature

Name

Title

Company

Date
AFFIDAVIT

"The undersigned swears that the foregoing statements are true and correct and include all material information necessary to identify and explain the operation of __________________________ (name of firm) as well as the ownership thereof. Further, the undersigned agrees to provide through the prime contractor or directly to the Contracting Officer current, complete and accurate information regarding actual work performed on the project, the payment therefore and any proposed changes, if any, of the project, the foregoing arrangements and to permit the audit and examination of books, records and files of the named firm. Any material misrepresentation will be grounds for terminating any contract which may be awarded and for initiating action under federal or state laws concerning false statements."

Note - If, after filing this information and before the work of this firm is completed on the contract covered by this regulation, there is any significant change in the information submitted, you must inform the Director of Facilities Planning and Development of the change either through the prime contractor or directly.

Signature ____________________________________________________________

Name ________________________________________________________________

Title _________________________________________________________________

Date __________________________________________________________________

Corporate Seal (where appropriate)

Date __________________________________________________________________

State of ______________________________________________________________

County of _____________________________________________________________

On this __________________ day of __________________, 19__, before me appeared (name) __________________ to me personally known, who, being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by (name of firm) __________________ to execute the affidavit and did so as his or her own free act and deed.

(Seal)

Notary Public ____________________________________________________________

Commission expires __________________________________________________________________
AFFIDAVIT FOR AFFIRMATIVE ACTION

State of Missouri  )
                ) ss.
County of ______________ )

_______________________________________________________________________ first being duly sworn on his/her oath states:  that he/she is the (sole proprietor, partner, or officer) of __________________________________________________
_______________________ a (sole proprietorship, partnership, corporation), and as such (sole proprietor, partner, or officer) is
duly authorized to make this affidavit on behalf of said (sole proprietorship, partnership, corporation); that under the contract
known as "___________________________________________________________________________________________"
Project No. ________________ less than 50 persons in the aggregate will be employed and therefore, the applicable Affirmative
Action requirements as set forth in the "Nondiscrimination in Employment Equal Opportunity," Supplemental Special
Conditions, and Article 13 in the General Conditions do not apply.

________________________________________

Subscribed and sworn before me this _______________ day of ___________________________, 19________.

My commission expires ___________________________________________________________, 19________.
CERTIFYING SUPPLIER DIVERSITY AGENCIES

Diverse firms are defined in General Conditions Articles 1.1.7 and those businesses must be certified as disadvantaged by an approved agency. The Bidder is responsible for obtaining information regarding the certification status of a firm. A list of certified firms may be obtained by contacting the agencies listed below. Any firm listed as disadvantaged by any of the following agencies will be classified as a diverse firm by the Owner.

St. Louis Development Corporation
1520 Market St., Ste. 2000
St. Louis, MO 63103
P: 314.982.1400
W: www.stlouis-mo.gov/sldc/

Bi-State Development
211 N. Broadway, Ste. 700
St. Louis, MO 63102
P: 314.982.1400
W: www.metrostlouis.dbesystem.com

St. Louis Minority Business Council
211 N. Broadway, Ste. 1300
St. Louis, MO 63102
P: 314.231.5555
W: www.slmbc.org

U.S. Small Business Administration - St. Louis, MO
8(a) Contractors, Minority Small Business
1222 Spruce Street, Suite 10.103
St. Louis, MO 63101
P: 314.539.6600
W: www.sba.gov

Lambert St. Louis International Airport
Business Diversity Development Office
11495 Navaid
Bridgeton, MO 63044
P: 314-426-8111

City of Kansas City, Missouri
Human Relations Department, MBE/WBE Division
4th Floor, City Hall
414 E. 12th Street
Kansas City, MO 64106
P: 816.513.1836
W: kcmohrd.mwdbce.com/?TN=kcmohrd

U.S. Small Business Administration - Kansas City, MO
8(a) Contractors, Minority Small Business
1000 Walnut, Suite 500
Kansas City, MO 64106
P: 816.426.4900
W: kcmohrd.mwdbce.com/?TN=kcmohrd

Missouri Department of Transportation
Division of Construction
1617 Missouri Blvd.
P.O. Box 270
Jefferson City, MO 65102
P: 573.526.2978
W: www.modot.org/mrcc-directory

Illinois Department of Transportation
MBE/WBE Certification Section
2300 Dirksen Parkway
Springfield, IL 62764
217/782-5490; 217/785-1524 (Fax)
W: webapps.dot.illinois.gov/UCP/ExternalSearch

State of Missouri OA
Office of Equal Opportunity
301 W. High St. HSC Rm 870-B
Jefferson City, MO 65101
P: 877.259.2963
W: oeo.mo.gov/

Missouri Department of Transportation
Division of Construction
1617 Missouri Blvd.
P.O. Box 270
Jefferson City, MO 65102
P: 573.526.2978
W: www.modot.org/mrcc-directory

Mid-States Minority Supplier Development Council
505 N. 7th Street, Ste. 1820
St. Louis, MO 63101
P: 314.278.5616
W: midstatesdc.org
Minority Newspapers

Dos Mundos Bilingual Newspaper
902A Southwest Blvd.
Kansas City, MO 64108
816-221-4747
www.dosmundos.com

Kansas City Hispanic News
2918 Southwest Blvd.
Kansas City, MO 64108
816/472-5246
www.kchispanicnews.com

The Kansas City Globe
615 E. 29th Street
Kansas City, MO 64109
816-531-5253
www.thekcglobe.com/about_us.php

St. Louis American
4144 Lindell
St. Louis, MO 63108
314-533-8000
www.stlamericancan.com

St. Louis Chinese American News
1766 Burns Ave, Suite 201
St. Louis, MO 63132
314-432-3858
www.scannews.com

St. Louis Business Journal
815 Olive St., Suite 100
St. Louis, MO 63101
314-421-6200
www.bizjournal.com/stlouis

Kansas City Business Journal
1100 Main Street, Suite 210
Kansas City, MO 64105
816-421-5900
www.bizjournals.com/kansascity
AFFIDAVIT OF SUPPLIER DIVERSITY PARTICIPATION

The apparent low Bidder shall complete and submit this form within 48 hours of bid opening for each Diverse firm that will participate on the contract.

1. Diverse Firm: __________________________________________
   Contact Name: __________________________________________
   Address: _______________________________________________
   Phone No.: ______________________ E-Mail: ____________________

   Status (check one)  MBE □  WBE □  Veteran □  Service Disabled Veteran □  DBE □
   If MBE, Certified as (circle one): 1) Black American   2) Hispanic American   3) Native American   4) Asian American

2. Is the proposed diverse firm certified by an approved agency [see IFB article 15]?  Yes □  No □
   Agency: ________________________________[attach copy of certification authorization from agency]
   Certification Number: ____________________________

3. Diverse firm scope work and bid/contract dollar amount of participation (List Base Bid and Alternate work separately). The final Dollar amount will be determined at substantial completion:

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<th>Scope of Work</th>
<th>Bid/Contract Amount</th>
<th>Final Dollar Amount</th>
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<td>Base Bid</td>
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<td>Alternate #5</td>
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<tr>
<td>Alternate #6</td>
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</table>

The undersigned certifies that the information contained herein (i.e. Scope of Work and Bid/Contract Amount) is true and correct to the best of their knowledge, information and belief.

   General Contractor: ____________________________  Diverse Firm: ____________________________
   Signature: ____________________________  Signature: ____________________________
   Name: ____________________________  Name: ____________________________
   Title: ____________________________  Title: ____________________________
   Date: ____________________________  Date: ____________________________

The undersigned certifies that the information contained herein (i.e. Scope of Work and Final Dollar Amount) is true and correct to the best of their knowledge, information and belief. If the Final Dollar Amount is different than the Bid/Contract Amount, then attach justification for the difference.

   Contractor: ____________________________  Diverse Firm: ____________________________
   Signature: ____________________________  Signature: ____________________________
   Name: ____________________________  Name: ____________________________
   Title: ____________________________  Title: ____________________________
   Date: ____________________________  Date: ____________________________
### University of Missouri

**INFORMATION FOR BIDDERS**

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<td>IFB/1</td>
<td>1. <strong>Contract Documents</strong>&lt;br&gt;1.1 Drawings, specifications, and other contract documents, pursuant to work which is to be done, may be obtained shown in the Advertisement for Bids and Special Conditions.</td>
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<tr>
<td>IFB/1</td>
<td>2. <strong>Bidder Obligations</strong>&lt;br&gt;2.1 Before submitting bids each bidder shall carefully examine the drawings and specifications and related contract documents, visit site of work and fully inform themselves as to all existing conditions, facilities, restrictions and other matters which can affect the work or the cost thereof.</td>
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<tr>
<td>IFB/1</td>
<td>2.2 Each bidder shall include in their bid the cost of all work and materials required to complete the contract in a first-class manner as hereinafter specified.</td>
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<tr>
<td>IFB/1</td>
<td>2.3 Failure or omission of any bidder to receive or examine any form, instrument, addendum, or other document, or to visit the site and acquaint themselves with existing conditions, shall in no way relieve them from any obligation with respect to their bid or contract, and no extra compensation will be allowed by reason of any thing or matter concerning which bidder should have fully informed themselves prior to bidding.</td>
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<tr>
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<td>2.4 Submission of bids shall be deemed acceptance of the above obligations and each and every obligation required to be performed by all of the contract documents in the event the bid is accepted.</td>
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<tr>
<td>IFB/1</td>
<td>3. <strong>Interpretation of Documents</strong>&lt;br&gt;3.1 If any prospective bidder is in doubt as to the true meaning of any part of the drawings and specifications or contract documents, they shall submit a written request to the Architect for an interpretation.</td>
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<tr>
<td>IFB/1</td>
<td>3.2 Requests for such interpretations shall be delivered to the Architect at least one (1) week prior to time for receipt of bids.</td>
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<td>IFB/1</td>
<td>4. <strong>Bids</strong>&lt;br&gt;4.1 Bids shall be received separately or in combination as shown in and required by the Bid for Lump Sum contract. Bids will be completed so as to include insertion of amounts for alternate bids, unit prices and cost accounting data.</td>
</tr>
<tr>
<td>IFB/1</td>
<td>4.2 Bidders shall apportion each base bid between various phases of the work, as stipulated in the Bid for Lump Sum contract. All work shall be done as defined in the specifications and as indicated on the drawings.</td>
</tr>
<tr>
<td>IFB/1</td>
<td>4.3 Bids shall be presented in sealed envelopes which shall be plainly marked &quot;Bids for (indicate name of project from cover sheet)&quot;, and mailed or delivered to the building and room number specified in the Advertisement for Bids. Bidders shall be responsible for actual delivery of bids during business hours, and it shall not be sufficient to show that a bid was mailed in time to be received before scheduled closing time for receipt of bids, nor shall it be sufficient to show that a bid was somewhere in a university facility.</td>
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<tr>
<td>IFB/1</td>
<td>4.4 The bidder's price shall include all federal sales, excise, and similar taxes, which may be lawfully assessed in connection with their performance of work and purchase of materials to be incorporated in the work. City &amp; State taxes shall not be included as defined within Article 3.16 of the General Conditions for Construction Contract included in the contract documents.</td>
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<tr>
<td>IFB/1</td>
<td>4.5 Bids shall be submitted on a single bid form, furnished by the Owner or Architect. Do not remove the bid form from the specifications.</td>
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<tr>
<td>IFB/1</td>
<td>4.6 No bidder shall stipulate in their bid any conditions not contained in the bid form.</td>
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**IFB/1**

04/18
4.7 The Owner reserves the right to waive informalities in bids and to reject any or all bids.

5. Modification and Withdrawal of Bids
5.1 The bidder may withdraw their bid at any time before the scheduled closing time for receipt of bids, but no bidder may withdraw their bid after the scheduled closing time for receipt of bids.

5.2 Only telegrams, letters and other written requests for modifications or correction of previously submitted bids, contained in a sealed envelope which is plainly marked "Modification of Bid on (name of project on cover sheet)," which are addressed in the same manner as bids, and are received by Owner before the scheduled closing time for receipt of bids will be accepted and bids corrected in accordance with such written requests.

6. Signing of Bids
6.1 Bids which are signed for a partnership shall be manually signed in the firm name by at least one partner, or in the firm name by Attorney-in-Fact. If signed by Attorney-in-Fact there should be attached to the bid, a Power of Attorney evidencing authority to sign the bid dated the same date as the bid and executed by all partners of the firm.

6.2 Bids that are signed for a corporation shall have the correct corporate name thereon and the signature of an authorized officer of the corporation manually written below corporate name. Title of office held by the person signing for the corporation shall appear below the signature of the officer.

6.3 Bids that are signed by an individual doing business under a firm name, shall be manually signed in the name of the individual doing business under the proper firm name and style.

6.4 Bids that are signed under joint venture shall be manually signed by officers of the firms having authority to sign for their firm.

7. Bid Security
7.1 Each bid shall be accompanied by a bid bond, certified check, or cashier's check, acceptable to and payable without condition to The Curators of the University of Missouri, in an amount at least equal to five percent (5%) of bidder's bid including additive alternates.

7.2 Bid security is required as a guarantee that bidder will enter into a written contract and furnish a performance bond within the time and in form as specified in these specifications; and if successful bidder fails to do so, the bid security will be realized upon or retained by the Owner. The apparent low bidder shall notify the Owner in writing within 48 hours (2 work days) of the bid opening of any circumstance that may affect the bid security including, but not limited to, a bidding error. This notification will not guarantee release of the bidder's security and/or the bidder from the Bidder's Obligations.

7.3 If a bid bond is given as a bid security, the amount of the bond may be stated as an amount equal to at least five percent (5%) of the bid, including additive alternates, described in the bid. The bid bond shall be executed by the bidder and a responsible surety licensed in the State of Missouri with a Best’s rating of no less than A-/XI.

7.4 It is specifically understood that the bid security is a guarantee and shall not be considered as liquidated damages for failure of bidder to execute and deliver the required contract and performance bond, nor limit or fix bidder's liability to Owner for any damages sustained because of failure to execute and deliver the required contract and performance bond.

7.5 Bid security of the two (2) lowest and responsive Bidders will be retained by the Owner until a contract has been executed and an acceptable bond has been furnished, as required hereby, when such bid security will be returned. Surety bonds of all other bidders will be destroyed and all other alternative forms of bid bonds will be returned to them within ten (10) days after Owner has determined the two (2) lowest and responsive bids.

8. Bidder's Statement of Qualifications
8.1 Each bidder submitting a bid shall present evidence of their experience, qualifications, financial responsibility and ability to carry out the terms of the contract by completing and submitting with their bid the schedule of information set forth in the form furnished in the bid form.

8.2 Such information, a single copy required in a separate sealed envelope, will be treated as confidential information by the Owner, within the meaning of Missouri Statue 610.010.

8.3 Bids not accompanied with current Bidder's Statement of Qualifications may be rejected.

9. Award of Contract
9.1 The Owner reserves the right to let other contracts in connection with the work, including, but not by way of limitation, contracts for furnishing and installation of furniture, equipment, machines, appliances, and other apparatus.

9.2 In awarding the contract, the Owner may take into consideration the bidder's, and their subcontractor's, ability to handle promptly the additional work, skill, facilities, capacity, experience, ability, responsibility, previous work, financial standing of bidder, and the bidder's ability to provide the required bonds and insurance; quality, efficiency and construction of equipment proposed to be furnished; period of time within which equipment is proposed to be furnished; success in achieving the specified Supplier Diversity goal, or demonstrating a good faith effort as described in Article 15; necessity of prompt and efficient completion of work herein described, and the bidder’s status as suspended or debarred. Inability of any bidder to meet the requirements mentioned above may be cause for rejection of their bid.

10. Contract Execution
10.1 The Contractor shall submit within fifteen (15) days from receipt of notice, the documents required in Article 9 of the General Conditions for Construction Contract included in the contract documents.
10.2 No bids will be considered binding upon the Owner until the documents listed above have been furnished. Failure of Contractor to execute and submit these documents within the time period specified will be treated, at the option of the Owner, as a breach of the bidder's bid security under Article 7 and the Owner shall be under no further obligation to Bidder.

11. Contract Security

11.1 When the Contract sum exceeds $50,000, the Contractor shall procure and furnish a Performance bond and a Payment bond in the form prepared by Owner. Each bond shall be in the amount equal to one hundred percent (100%) of the contract sum, as well as adjustments to the Contract Sum. The Performance Bond shall secure and guarantee Contractor’s faithful performance of this Contract, including but not limited to Contractor’s obligation to correct defects after final payment has been made as required by the Contract Documents. The Payment Bond shall secure and guarantee payment of all persons performing labor on the Project under this Contract and furnishing materials in connection with this Contract. These Bonds shall be in effect through the duration of the Contract plus the Guaranty Period as required by the Contract Documents.

11.2 The bonds required hereunder shall be meet all requirements of Article 11 of the General Conditions for Construction Contract included in the contract documents.

11.3 If the surety of any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to conduct business in the State of Missouri is terminated, or it ceases to meet the requirements of this Article 11, Contractor shall within ten (10) days substitute another bond and surety, both of which must be acceptable to Owner. If Contractor fails to make such substitution, Owner may procure such required bonds on behalf of Contractor at Contractor’s expense.

12. Time of Completion

12.1 Contractors shall agree to commence work within five (5) days of the date "Notice to Proceed" is received from the Owner, and the entire work shall be completed by the completion date specified or within the number of consecutive calendar days stated in the Special Conditions. The duration of the construction period, when specified in consecutive calendar days, shall begin when the contractor receives notice requesting the documents required in Article 9 of the General Conditions for Construction Contract included in the contract documents.

13. Number of Contract Documents

13.1 The Owner will furnish the Contractor a copy of the executed contract and performance bond.

13.2 The Owner will furnish the Contractor the number of copies of complete sets of drawings and specifications for the work, as well as, clarification and change order drawings pertaining to change orders required during construction as set forth in the Special Conditions.

14. Missouri Products and Missouri Firms

14.1 The Curators of the University of Missouri have adopted a policy which is binding upon all employees and departments of the University of Missouri, and which by contract, shall be binding upon independent contractors and subcontractors with the University of Missouri whereby all other things being equal, and when the same can be secured without additional cost over foreign products, or products of other states, a preference shall be granted in all construction, repair and purchase contracts, to all products, commodities, materials, supplies and articles mined, grown, produced and manufactured in marketable quantity and quality in the State of Missouri, and to all firms, corporations or individuals doing business as Missouri firms, corporations or individuals. Each bidder submitting a bid agrees to comply with, and be bound by the foregoing policy.

15. Supplier Diversity

15.1 Award of Contract

The Supplier Diversity participation goal for this project is stated on the Bid for Lump Sum Contract Form, and the Owner will take into consideration the bidder's success in achieving the Supplier Diversity participation goal in awarding the contract. Inability of any bidder to meet this requirement may be cause for rejection of their bid.

The University will grant a three (3) point bonus preference to a Missouri based, certified Service Disabled Veteran Enterprise (SDVE) bidder as defined in Article 1 – (Supplier Diversity Definitions) of the General Conditions of the Contract for Construction included in the contract documents. The three percent (3%) goal can be met, and the bonus points obtained, by a qualified SDVE vendor and/or through the use of qualified subcontractors or suppliers that provide at least three percent (3%) of the total contract value.

15.2 List of Supplier Diversity Firms

15.2.1 The bidder shall submit as part of their bid a list of diverse firms performing as contractor, subcontractors, and/or suppliers. The list shall specify the single designated diverse firm name and address. If acceptance or non-acceptance of alternates will affect the designation of a subcontractor, provide information for each affected category.

15.2.2 Failure to include a complete list of diverse firms may be grounds for rejection of the bid.

15.2.3 The list of diverse firms shall be submitted in addition to any other listing of subcontractors required in the Bid for Lump Sum Contract Form.

15.3 Supplier Diversity Percentage Goal

The bidder shall have a minimum goal of subcontracting with diverse contractors, subcontractors, and suppliers, the percent of contract price stated in the Supplier Diversity goal paragraph of the Bid for Lump Sum Contract Form.

15.4 Supplier Diversity Percent Goal Computation

15.4.1 The total dollar value of the work granted to the diverse firms by the successful bidder is counted towards the applicable goal of the entire contract, unless otherwise noted below.

15.4.2 The bidder may count toward the Supplier Diversity goal only expenditures to diverse firms that perform a commercially useful function in the work of a contract. A diverse firm is considered to perform a commercially useful function when it is responsible for executing a distinct element of the work and carrying out its responsibilities by
actually performing, managing and supervising the work involved. A bidder that is a certified diverse firm may count as 100% of the contract towards the Supplier Diversity goal. For projects with separate MBE, SDVE, and WBE/Veteran/DBE goals, a MBE firm bidding as the prime bidder is expected to obtain the required SDVE, and WBE/Veteran/DBE participation; a WBE or Veteran or DBE firm bidding as the prime bidder is expected to obtain the required MBE and SDVE participation and a SDVE firm bidding as the prime bidder is expected to obtain the required MBE, and WBE/Veteran/DBE participation.

15.4.3 When a MBE, WBE, Veteran Business Enterprise, DBE, or SDVE performs work as a participant in a joint venture, only the portion of the total dollar value of the contract equal to the distinct, clearly defined portion of the work of the contract that the MBE, WBE, Veteran Business Enterprise, DBE, or SDVE performs with its own forces shall count toward the MBE, WBE, Veteran Business Enterprise, DBE, or SDVE individual contract percentages.

15.4.4 The bidder may count toward its Supplier Diversity goal expenditures for materials and supplies obtained from diverse suppliers and manufacturers, provided the diverse firm assumes the actual and contractual responsibility for the provision of the materials and supplies.

15.4.4.1 The bidder may count its entire expenditure to a diverse manufacturer. A manufacturer shall be defined as an individual or firm that produces goods from raw materials or substantially alters them before resale.

15.4.4.2 The bidder may count its entire expenditure to diverse suppliers that are not manufacturers provided the diverse supplier performs a commercially useful function as defined above in the supply process.

15.4.4.3 The bidder may count 25% of its entire expenditures to diverse firms that do not meet the definition of a subcontractor, a manufacturer, nor a supplier. Such diverse firms may arrange for, expedite, or procure portions of the work but are not actively engaged in the business of performing, manufacturing, or supplying that work.

15.4.5 The bidder may count toward the Supplier Diversity goal that portion of the total dollar value of the work awarded to a certified joint venture equal to the percentage of the ownership and control of the diverse partner in the joint venture.

15.4.6 On projects with separate MBE and WBE/Veteran/DBE goals, the Owner may allow MBE participation provided in excess of the MBE goal to be counted towards the WBE/Veteran/DBE goal.

15.5 Certification by Bidder of Diverse Firms

15.5.1 The bidder shall submit with its bid the information requested in the "Supplier Diversity Compliance Evaluation Form" for every diverse firm the bidder intends to award work to on the contract.

15.5.2 Diverse firms are defined in Article 1 – (Supplier Diversity Definitions) of the General Conditions of the Contract for Construction included in the contract documents, and as those businesses certified as disadvantaged by an approved agency. The bidder is responsible for obtaining information regarding the certification status of a firm. A list of certified firms may be obtained by contacting the agencies listed in the proposal form document “Supplier Diversity Certifying Agencies”. Any firm listed as disadvantaged by any of the identified agencies will be classified as a diverse firm by the Owner.

15.5.3 Bidders are urged to encourage their prospective diverse contractors, subcontractors, joint venture participants, team partners, and suppliers who are not currently certified to obtain certification from one of the approved agencies.

15.6 Supplier Diversity Participation Waiver

15.6.1 The bidder is required to make a good faith effort to locate and contract with diverse firms. If a bidder has made a good faith effort to secure the required diverse firms and has failed, the bidder shall submit with the bid, the information requested in "Application for Supplier Diversity Participation Waiver." The Contracting Officer will review the bidder's actions as set forth in the bidder's "Application for Waiver" and any other factors deemed relevant by the Contracting Officer to determine if a good faith effort has been made to meet the applicable percentage goal. If the bidder is judged not to have made a good faith effort, the bid may be rejected. Bidder's who demonstrate that they have made a good faith effort to include Supplier Diversity participation may be awarded the contract regardless of the percent of Supplier Diversity participation, provided the bid is otherwise acceptable and is determined to be the best bid.

15.6.2 To determine good faith effort of the bidder, the Contracting Officer may evaluate factors including, but not limited to, the following:

15.6.2.1 The bidder’s attendance at pre-proposal meetings scheduled to inform bidders and diverse firms of contracting and subcontracting opportunities and responsibilities associated with Supplier Diversity participation.

15.6.2.2 The bidder’s advertisements in general circulation trade association, and diverse (minority) focused media concerning subcontracting opportunities.

15.6.2.3 The bidder’s written notice to specific diverse firms that their services were being solicited in sufficient time to allow for their effective participation.

15.6.2.4 The bidder’s follow-up attempts to the initial solicitation(s) to determine with certainty whether diverse firms were interested.

15.6.2.5 The bidder’s efforts to divide the work into packages suitable for subcontracting to diverse firms.

15.6.2.6 The bidder’s efforts to provide interested diverse firms with sufficiently detailed information about the drawings, specific actions and requirements of the contract, and clear scopes of work for the firms to bid on.
The bidder’s efforts to solicit for specific sub-bids from diverse firms in good faith. Documentation should include names, addresses, and telephone numbers of firms contacted a description of all information provided the diverse firms, and an explanation as to why agreements were not reached.

The bidder’s efforts to locate diverse firms not on the directory list and assist diverse firms in becoming certified as such.

The bidder's initiatives to encourage and develop participation by diverse firms.

The bidder’s efforts to help diverse firms overcome legal or other barriers impeding the participation of diverse firms in the construction contract.

The availability of diverse firms and the adequacy of the bidder's efforts to increase the participation of such business provided by the persons and organizations consulted by the bidder.

16. List of Subcontractors

16.1 If a list of subcontractors is required on the Bid for Lump Sum Contract Form, the bidders shall list the name, city and state of the firm(s) which will accomplish that portion of the contract requested in the space provided. This list is separate from both the list of diverse firms required in Article 15.2, and the complete list of subcontractors required in Article 10.1 of this document. Should the bidder choose to perform any of the listed portions of the work with its own forces, the bidder shall enter its own name, city and state in the space provided. If acceptance or non-acceptance of alternates will affect the designation of a subcontractor, the bidder shall provide that information on the bid form.

16.2 Failure of the bidder to supply the list of subcontractors required or the listing of more than one subcontractor for any category without designating the portion of the work to be performed by each, shall be grounds for the rejection of the bid. The bidder can petition the Owner to change a listed subcontractor within 48 hours of the bid opening. The Owner reserves the right to make the final determination on a petition to change a subcontractor. The Owner will consider factors such as clerical and mathematical bidding errors, listed subcontractor’s inability to perform the work for the bid used, etc. Any request to change a listed subcontractor shall include at a minimum, contractor’s bid sheet showing tabulation of the bid; all subcontractor bids with documentation of the time they were received by the contractor; and a letter from the listed subcontractor on their letterhead stating why they cannot perform the work if applicable. The Owner reserves the right to ask for additional information.

16.3 Upon award of the contract, the requirements of Article 10 of this document and Article 5 of the General Conditions of the Contract for Construction included in the contract documents will apply.
General Conditions

of the

Contract

for

Construction

August 2018 Edition
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ARTICLE 1
GENERAL PROVISIONS

1.1 Basic Definitions
As used in the Contract Documents, the following terms shall have the meanings and refer to the parties designated in these definitions.

1.1.1 Owner
The Curators of the University of Missouri. The Owner may act through its Board of Curators or any duly authorized committee or representative thereof.

1.1.2 Contracting Officer
The Contracting Officer is the duly authorized representative of the Owner with the authority to execute contracts. Communications to the Contracting Officer shall be forwarded via the Owner's Representative.

1.1.3 Owner's Representative
The Owner’s Representative is authorized by the Owner as the administrator of the Contract and will represent the Owner during the progress of the Work. Communications from the Architect to the Contractor and from the Contractor to the Architect shall be through the Owner's Representative, unless otherwise indicated in the Contract Documents.

1.1.4 Architect
When the term "Architect" is used herein, it shall refer to the Architect or the Engineer specified and defined in the Contract for Construction or its duly authorized representative. Communications to the Architect shall be forwarded to the address shown in the Contract for Construction.

1.1.5 Contractor
The Contractor is the person or entity with whom the Owner has entered into the Contract for Construction. The term “Contractor” means the Contractor or the Contractor’s authorized representative.

1.1.6 Subcontractor and Lower-tier Subcontractor
A Subcontractor is a person or organization who has a contract with the Contractor to perform any of the Work. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or its authorized representative. The term "Subcontractor" also is applicable to those furnishing materials to be incorporated in the Work whether work performed is at the Owner’s site or off site, or both. A lower-tier Subcontractor is a person or organization who has a contract with a Subcontractor or another lower-tier Subcontractor to perform any of the Work at the site. Nothing contained in the Contract Documents shall create contractual relationships between the Owner or the Architect and any Subcontractor or lower-tier Subcontractor of any tier.

1.1.7 Supplier Diversity Definitions
Businesses that fall into the Supplier Diversity classification shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more diverse suppliers as described below.

.1 Minority Business Enterprises (MBE)
Minority Business Enterprise [MBE] shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more minorities as defined below or, in the case of any publicly-owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more minorities as defined below, and whose management and daily business operations are controlled by one (1) or more minorities as defined herein.

.1.1 "African Americans", which includes persons having origins in any of the black racial groups of Africa.

.1.2 "Hispanic Americans", which includes persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race.

.1.3 "Native Americans", which includes persons of American Indian, Eskimo, Aleut, or Native Hawaiian origin.

.1.4 "Asian-Pacific Americans", which includes persons whose origins are from Japan, China, Taiwan, Korea, Vietnam, Laos, Cambodia, the Philippines, Samoa, Guam, the U.S. Trust Territories of the Pacific, or the Northern Marinas.

.1.5 "Asian-Indian Americans", which includes persons whose origins are from India, Pakistan, or Bangladesh.

.2 Women Business Enterprise (WBE)
Women Business Enterprise [WBE] shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more women or, in the case of any publicly-owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more women, and whose management and daily business operations are controlled by one (1) or more women.

.3 Veteran Owned Business
Veteran Owned Business shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more Veterans or, in the case of any publicly-owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more Veterans, and whose management and daily business operations are controlled by one (1) or more Veterans. Veterans must be certified by the appropriate federal agency responsible for veterans’ affairs.

.4 Service Disabled Veteran Enterprise (SDVE)
Service Disabled Veteran Enterprise (SDVE) shall mean a business certified by the State of Missouri Office of Administration as a Service Disabled Veteran Enterprise, which is at least fifty-one percent (51%) owned and controlled by one (1) or more Serviced Disabled Veterans or,
in the case of any publicly-owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more Service Disabled Veterans, and whose management and daily business operations are controlled by one (1) or more Serviced Disabled Veterans.

.5 Disadvantaged Business Enterprise (DBE)
A Disadvantaged Business Enterprise (DBE) is a for-profit small business concern where a socially and economically disadvantaged individual owns at least 51% interest and also controls management and daily business operations. These firms can and also be referred to as Small Disadvantaged Businesses (SDB). Eligibility requirements for certification are stated in 49 CFR (Code of Federal Regulations), part 26, Subpart D.

U.S. citizens that are African-Americans, Hispanics, Native Americans, Asian-Pacific and Subcontinent Asian Americans, and women are presumed to be socially and economically disadvantaged. Also recognized as DBE’s are Historically Black Colleges and Universities (HBCU) and small businesses located in Federal HUB Zones. To be regarded as economically disadvantaged, an individual must have a personal net worth that does not exceed $1.32 million. To be seen as a small business, a firm must meet Small Business Administration (SBA) size criteria (500 employees or less) and have average annual gross receipts not to exceed $22.41 million. To be considered a DBE/SDB, a small business owned and controlled by socially and/or economically disadvantaged individuals must receive DBE certification from one of the recognized Missouri state agencies to be recognized in this classification.

1.1.9 Work
Work shall mean supervision, labor, equipment, tools, material, supplies, incidentals operations and activities required by the Contract Documents or reasonably inferable by Contractor therefrom as necessary to produce the results intended by the Contract Documents in a safe, expeditious, orderly, and workmanlike manner, and in the best manner known to each respective trade.

1.1.10 Approved
The terms "approved", "equal to", "directed", "required", "ordered", "designated", "acceptable", "satisfactory", and similar words or phrases will be understood to have reference to action on the part of the Architect and/or the Owner's Representative.

1.1.11 Contract Documents
The Contract Documents consist of (1) the executed Contract for Construction, (2) these General Conditions of the Contract for Construction, (3) any Supplemental Conditions or Special Conditions identified in the Contract for Construction, (4) the Specifications identified in the Contract for Construction, (5) the Drawings identified in the Contract for Construction, (6) Addenda issued prior to the receipt of bids, (7) Contractor’s bid addressed to Owner, including Contractor’s completed Qualification Statement, (8) Contractor’s Performance Bond and Contractor’s Payment Bond, (9) Notice to Proceed, (10) and any other exhibits and/or post bid adjustments identified in the Contract for Construction, (11) Advertisement for Bid, (12) Information for Bidders, and (13) Change Orders issued after execution of the Contract. All other documents and technical reports and information are not Contract Documents, including without limitation, Shop Drawings, and Submittals.

1.1.12 Contract
The Contract Documents form the Contract and are the exclusive statement of agreement between the parties. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior representations or agreements, either written or oral. The Contract Documents shall not be construed to create a contractual relationship of any kind between the Owner and a Subcontractor or any lower-tier Subcontractor.

1.1.13 Change Order
The Contract may be amended or modified without invalidating the Contract, only by a Change Order, subject to the limitations in Article 7 and elsewhere in the Contract Documents. A Change Order is a written instrument signed by the Owner and the Contractor stating their agreement to a change in the Work, the amount of the adjustment to the Contract Sum, if any, and the extent of the adjustment to the Contract Time, if any. Agreement to any Change Order shall constitute a final settlement of all matters relating to the change in the work which is the subject of the Change Order, including, but not limited to, all direct and indirect costs associated with such change and any and all adjustments of the Contract sum, time and schedule.

1.1.14 Substantial Completion
The terms “Substantial Completion” or "substantially complete" as used herein shall be construed to mean the completion of the entire Work, including all submittals required under the Contract Documents, except minor items which in the opinion of the Architect, and/or the Owner's Representative will not interfere with the complete and satisfactory use of the facilities for the purposes intended.

1.1.15 Final Completion
The date when all punch list items are completed, including all closeout submittals and approval by the Architect is given to the Owner in writing.

1.1.16 Supplemental and Special Conditions
The terms “Supplemental Conditions” or “Special Conditions” shall mean the part of the Contract Documents which amend, supplement, delete from, or add to these General Conditions.

1.1.17 Day
The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

1.1.18 Knowledge.
The terms “knowledge,” “recognize” and “discover,” their respective derivatives and similar terms in the Contract Documents, as used in reference to the Contractor, shall be interpreted to mean that which the Contractor knows or should know, recognizes or should recognize and discovers or should discover in exercising the care, skill, and diligence of a diligent and prudent contractor familiar with the work. Analogously, the expression “reasonably inferable” and similar terms in the Contract Documents shall be interpreted to mean reasonably inferable by a diligent and prudent contractor familiar with the work.

1.1.19 Punch List
“Punch List” means the list of items, prepared in connection with the inspection of the Project by the Owner’s Representative or Architect in connection with Substantial Completion of the Work or a portion of the Work, which the Owner’s Representative or Architect has designated as remaining to be performed, completed or corrected before the Work will be accepted by the Owner.

1.1.20 Public Works Contracting Minimum Wage
The public works contracting minimum wage shall be equal to one hundred twenty percent of the average hourly wage in a particular locality, as determined by the Missouri economic research and information center within the department of economic development, or any successor agency.

1.2 Specifications and Drawings
1.2.1 The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, construction system, standards and workmanship and performance of related services for the Work identified in the Contract for Construction. Specifications are separated into titled divisions for convenience of reference only. Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. Such separation will not operate to make the Owner or the Architect an arbiter of labor disputes or work agreements.

1.2.2 The drawings herein referred to, consist of drawings prepared by the Architect and are enumerated in the Contract Documents.

1.2.3 Drawings are intended to show general arrangements, design, and dimensions of work and are partly diagrammatic. Dimensions shall not be determined by scale or rule. If figured dimensions are lacking, they shall be supplied by the Architect on the Contractor’s written request to the Owner's Representative.

1.2.4 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complimentary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall by required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results.

1.2.5 In the event of inconsistencies within or between parts of the Contract Documents, or between the Contract Documents and applicable standards, codes and ordinances, the Contractor shall (1) provide the better quality or greater quantity of Work or (2) comply with the more stringent requirement; either or both in accordance with the Owner’s Representative’s interpretation. On the Drawings, given dimensions shall take precedence over scaled measurements and large scale drawings over small scale drawings. Before ordering any materials or doing any Work, the Contractor and each Subcontractor shall verify measurements at the Work site and shall be responsible for the correctness of such measurements. Any difference which may be found shall be submitted to the Owner’s Representative and Architect for resolution before proceeding with the Work. If a minor change in the Work is found necessary due to actual field conditions, the Contractor shall submit detailed drawings of such portion for the approval by the Owner’s Representative and Architect before making the change.

1.2.6 Data in the Contract Documents concerning lot size, ground elevations, present obstructions on or near the site, locations and depths of sewers, conduits, pipes, wires, etc., position of sidewalks, curbs, pavements, etc., and nature of ground and subsurface conditions have been obtained from sources the Architect believes reliable, but the Architect and Owner do not represent or warrant that this information is accurate or complete. The Contractor shall verify such data to the extent possible through normal construction procedures, including but not limited to contacting utility owners and by prospecting.

1.2.7 Only work included in the Contract Documents is authorized, and the Contractor shall do no work other than that described therein.
1.2.8 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents. Contractor represents that it has performed its own investigation and examination of the Work site and its surroundings and satisfied itself before entering into this Contract as to:

.1 conditions bearing upon transportation, disposal, handling, and storage of materials;
.2 the availability of labor, materials, equipment, water, electrical power, utilities and roads;
.3 uncertainties of weather, river stages, flooding and similar characteristics of the site;
.4 conditions bearing upon security and protection of material, equipment, and Work in progress;
.5 the form and nature of the Work site, including the surface and sub-surface conditions;
.6 the extent and nature of Work and materials necessary for the execution of the Work and the remedying of any defects therein; and
.7 the means of access to the site and the accommodations it may require and, in general, shall be deemed to have obtained all information as to risks, contingencies and other circumstances.
.8 the ability to complete work without disruption to normal campus activities, except as specifically allowed in the contract documents.

The Owner assumes no responsibility or liability for the physical condition or safety of the Work site or any improvements located on the Work site. The Contractor shall be solely responsible for providing a safe place for the performance of the Work. The Owner shall not be required to make any adjustment in either the Contract Sum or Contract Time concerning any failure by the Contractor or any Subcontractor to comply with the requirements of this Paragraph.

1.2.9 Drawings, specifications, and copies thereof furnished by the Owner are and shall remain the Owner’s property. They are not to be used on another project and, with the exception of one contract set for each party to the Contract, shall be returned to the Owner's Representative on request, at the completion of the Work.

1.3 Required Provisions Deemed Inserted
Each and every provision of law and clause required by law to be inserted in this Contract shall be deemed to be inserted herein, and the Contract shall be read and enforced as though it were included herein; and if through mistake or otherwise any such provision is not inserted, or is not correctly inserted, then upon the written application of either party the Contract shall forthwith be physically amended to make such insertion or correction.

ARTICLE 2
OWNER

2.1 Information and Services Required of the Owner
2.1.1 Permits and fees are the responsibility of the Contractor under the Contract Documents, unless specifically stated in the contract documents that the Owner will secure and pay for specific necessary approvals, easements, assessments, and charges required for construction, use or occupancy of permanent structures, or for permanent changes in existing facilities.

2.1.2 When requested in writing by the Contractor, information or services under the Owner's control, which are reasonably necessary to perform the Work, will be furnished by the Owner with reasonable promptness to avoid delay in the orderly progress of the Work.

2.2 Owner's Right to Stop the Work
2.2.1 If the Contractor fails to correct Work which is not in strict accordance with the requirements of the Contract Documents or fails to carry out Work in strict accordance with the Contract Documents, the Owner has the right to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work will not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity. Owner’s lifting of Stop Work Order shall not prejudice Owner’s right to enforce any provision of this Contract.

2.3 Owner's Right to Carry Out the Work
2.3.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents, and fails within a seven (7) day period after receipt of a written notice from the Owner to correct such default or neglect, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. In such case, an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the cost of correcting such deficiencies. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to Owner. However, such notice shall be waived in the event of an emergency with the potential for property damage or the endangerment of students, faculty, staff, the public or construction personnel, at the sole discretion of the Owner.

2.3.2 In the event the Contractor has not satisfactorily completed all items on the Punch List within thirty (30) days of its receipt, the Owner reserves the right to complete the Punch List without further notice to the Contractor or its subcontractors.
surety. In such case, Owner shall be entitled to deduct from payments then or thereafter due the Contractor the cost of completing the Punch List items, including compensation for the Architect's additional services. If payments then or thereafter due Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to Owner.

2.4 Extent of Owner Rights
2.4.1 The rights stated in this Article 2 and elsewhere in the Contract Documents are cumulative and not in limitation of any rights of the Owner (1) granted in the Contract Documents, (2) at law or (3) in equity.

2.4.2 In no event shall the Owner have control over, charge of, or any responsibility for construction means, methods, techniques, sequences or procedures or for safety precautions and programs in connection with the Work, notwithstanding any of the rights and authority granted the Owner in the Contract Documents.

ARTICLE 3
CONTRACTOR

3.1 Contractor's Warranty
3.1.1 The Contractor warrants all equipment and materials furnished, and work performed, under this Contract, against defective materials and workmanship for a period of twelve months after acceptance as provided in this Contract, unless a longer period is specified, regardless of whether the same were furnished or performed by the Contractor or any Subcontractors of any tier. Upon written notice from the Owner of any breach of warranty during the applicable warranty period due to defective material or workmanship, the affected part or parts thereof shall be repaired or replaced by the Contractor at no cost to the Owner. Should the Contractor fail or refuse to make the necessary repairs, replacements, and tests when requested by the Owner, the Owner may perform, or cause the necessary work and tests to be performed, at the Contractor's expense, or exercise the Owner's rights under Article 14.

3.1.2 Should one or more defects mentioned above appear within the specified period, the Owner shall have the right to continue to use or operate the defective part or apparatus until the Contractor makes repairs or replacements or until such time as it can be taken out of service without loss or inconvenience to the Owner.

3.1.3 The above warranties are not intended as a limitation, but are in addition to all other express warranties set forth in this Contract and such other warranties as are implied by law, custom, and usage of trade. The Contractor, and its surety or sureties, if any, shall be liable for the satisfaction and full performance of the warranties set forth herein.

3.1.4 Neither the final payment nor any provision in the Contract Documents nor partial or entire occupancy of the premises by the Owner, nor expiration of warranty stated herein, will constitute an acceptance of Work not done in accordance with the Contract Documents or relieve the Contractor of liability in respect to any responsibility for non-conforming work. The Contractor shall immediately remedy any defects in the Work and pay for any damage to other Work resulting therefrom upon written notice from the Owner. Should the Contractor fail or refuse to remedy the non-conforming work, the Owner may perform, or cause to be performed the work necessary to bring the work into conformance with the Contract Documents at the Contractor's expense.

3.1.5 The Contractor agrees to defend, indemnify, and save harmless The Curators of the University of Missouri, their Officers, Agents, Employees and Volunteers, from and against all loss or expense from any injury or damages to property of others suffered or incurred on account of any breach of the aforesaid obligations and covenants. The Contractor agrees to investigate, handle, respond to and provide defense for and defend against any such liability, claims, and demands at the sole expense of the Contractor, or at the option of the University, agrees to pay to or reimburse the University for the defense costs incurred by the University in connection with any such liability claims, or demands. The parties hereto understand and agree that the University is relying on, and does not waive or intend to waive by any provision of this Contract, any monetary limitations or any other rights, immunities, and protections provided by the State of Missouri, as from time to time amended, or otherwise available to the University, or its officers, employees, agents or volunteers.

3.2 Compliance with Laws, Permits, Regulations and Inspections
3.2.1 The Contractor shall, without additional expense to the Owner, comply with all applicable laws, ordinances, rules, statutes, and regulations (collectively referred to as "Laws").

3.2.2 Since the Owner is an instrumentality of the State of Missouri, municipal, or political subdivision, ordinances, zoning ordinances, and other like ordinances are not applicable to construction on the Owner's property, and the Contractor will not be required to submit plans and specifications to any municipal or political subdivision authority to obtain construction permits or any other licenses or permits from or submit to, inspection by any municipality or political subdivision relating to the construction on the Owner's property, unless required by the Owner in these Contract Documents or otherwise in writing.
3.2.3 All fees, permits, inspections, or licenses required by municipality or political subdivision for operation on property not belonging to the Owner, shall be obtained by and paid for by the Contractor. The Contractor, of its own expense, is responsible to ensure that all inspections required by said permits or licenses on property, easements, or utilities not belonging to the Owner are conducted as required therein. All connection charges, assessments or transportation fees as may be imposed by any utility company or others are included in the Contract Sum and shall be the Contractor’s responsibility, as stated in 2.1.1 above.

3.2.4 If the Contractor has knowledge that any Contract Documents are at variance with any Laws, including Americans with Disabilities Act – Standards for Accessible Design, ordinances, rules, regulations or codes applying to the Work, Contractor shall promptly notify the Architect and the Owner’s Representative, in writing, and any necessary changes will be adjusted as provided in Contract Documents. However, it is not the Contractor’s primary responsibility to ascertain that the Contract Documents are in accordance with applicable Laws, unless such Laws bear upon performance of the Work.

3.3 Anti-Kickback
3.3.1 No member or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this Contract or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this Contract if made with a corporation for its general benefit.

3.3.2 No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept or approve, or to take part in negotiating, making, accepting, or approving any architectural, engineering, inspection, construction, or material supply contract or any Subcontract of any tier in connection with the construction of the Work shall have a financial interest in this Contract or in any part thereof, any material supply contract, Subcontract of any tier, insurance contract, or any other contract pertaining to the Work.

3.4 Supervision and Construction Procedures
3.4.1 The Contractor shall supervise and direct the Work, using the Contractor’s best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work under the Contract. The Contractor shall supply sufficient and competent supervision and personnel, and sufficient material, plant, and equipment to prosecute the Work with diligence to ensure completion thereof within the time specified in the Contract Documents, and shall pay when due any laborer, Subcontractor of any tier, or supplier.

3.4.2 The Contractor, if an individual, shall give the Work an adequate amount of personal supervision, and if a partnership or corporation or joint venture the Work shall be given an adequate amount of personal supervision by a partner or executive officer, as determined by the Owner's Representative.

3.4.3 The Contractor and each of its Subcontractors of any tier shall submit to the Owner such schedules of quantities and costs, progress schedules in accordance with 3.17.2 of this document, payrolls, reports, estimates, records, and other data as the Owner may request concerning Work performed or to be performed under the Contract.

3.4.4 The Contractor shall be represented at the site by a competent superintendent from the beginning of the Work until its final acceptance, whenever contract work is being performed, unless otherwise permitted in writing by the Owner's Representative. The superintendent for the Contractor shall exercise general supervision over the Work and such superintendent shall have decision making authority of the Contractor. Communications given to the superintendent shall be binding as if given to the Contractor. The superintendent shall not be changed by the contractor without approval from the Owner’s Representative.

3.4.5 The Contractor shall establish and maintain a permanent bench mark to which access may be had during progress of the Work, and Contractor shall establish all lines and levels, and shall be responsible for the correctness of such. Contractor shall be fully responsible for all layout work for the proper location of Work in strict accordance with the Contract Documents.

3.4.6 The Contractor shall establish and be responsible for wall and partition locations. If applicable, separate contractors shall be entitled to rely upon these locations and for setting their sleeves, openings, or chases.

3.4.7 The Contractor’s scheduled outage/tie-in plan, time, and date for any utilities is subject to approval by the Owner’s Representative. Communication with the appropriate entity and planning for any scheduled outage/tie-in of utilities shall be the responsibility of the Contractor. Failure of Contractor to comply with the provisions of this Paragraph shall cause Contractor to forfeit any right to an adjustment of the Contract Sum or Contract Time for any postponement, rescheduling or other delays ordered by Owner in connection with such Work. The Contractor shall follow the following procedures for all utility outages/tie-ins or disruption of any building system:

.1 All shutting of valves, switches, etc., shall be by the Owner’s personnel.
.2 Contractor shall submit its preliminary outage/tie-in schedule with its baseline schedule.

.3 The Contractor shall request an outage/tie-in meeting at least two weeks before the outage/tie-in is required.

.4 The Owner's Representative will schedule an outage/tie-in meeting at least one week prior to the outage/tie-in.

3.4.8 The Contractor shall coordinate all Work so there shall be no prolonged interruption of existing utilities, systems and equipment of Owner. Any existing plumbing, heating, ventilating, air conditioning, or electrical disconnection necessary, which affect portions of this construction or building or any other building, must be scheduled with the Owner's Representative to avoid any disruption of operation within the building under construction or other buildings or utilities. In no case shall utilities be left disconnected at the end of a work day or over a weekend. Any interruption of utilities, either intentionally or accidentally, shall not relieve the Contractor from repairing and restoring the utility to normal service. Repairs and restoration shall be made before the workers responsible for the repair and restoration leave the job.

3.4.9 The Contractor shall be responsible for repair of damage to property on or off the project occurring during construction of project, and all such repairs shall be made to meet code requirements or to the satisfaction of the Owner's Representative if code is not applicable.

3.4.10 The Contractor shall be responsible for all shoring required to protect its work or adjacent property and shall pay for any damage caused by failure to shore or by improper shoring or by failure to give proper notice. Shoring shall be removed only after completion of permanent supports.

3.4.11 The Contractor shall maintain at his own cost and expense, adequate, safe and sufficient walkways, platforms, scaffolds, ladders, hoists and all necessary, proper, and adequate equipment, apparatus, and appliances useful in carrying on the Work and which are necessary to make the place of Work safe and free from avoidable danger for students, faculty, staff, the public and construction personnel, and as may be required by safety provisions of applicable laws, ordinances, rules regulations and building and construction codes.

3.4.12 During the performance of the Work, the Contractor shall be responsible for providing and maintaining warning signs, lights, signal devices, barricades, guard rails, fences, and other devices appropriately located on site which shall give proper and understandable warning to all persons of danger of entry onto land, structure, or equipment, within the limits of the Contractor’s work area.

3.4.13 The Contractor shall pump, bail, or otherwise keep any general excavations free of water. The Contractor shall keep all areas free of water before, during and after concrete placement. The Contractor shall be responsible for protection, including weather protection, and proper maintenance of all equipment and materials installed, or to be installed by him.

3.4.14 The Contractor shall be responsible for care of the Work and must protect same from damage of defacement until acceptance by the Owner. All damaged or defaced Work shall be repaired or replaced to the Owner's satisfaction, without cost to the Owner.

3.4.15 When requested by the Owner's Representative, the Contractor, at no extra charge, shall provide scaffolds or ladders in place as may be required by the Architect or the Owner for examination of Work in progress or completed.

3.4.16 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor’s employees, Subcontractors of any tier and their agents and employees, and any entity or other persons performing portions of the Work.

3.4.17 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Owner’s Representative or Architect in their administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.

3.4.18 The Contractor shall be responsible for inspection of portions of the Work already performed under this Contract to determine that such portions are in proper condition to receive subsequent Work.

3.5 Use of Site

3.5.1 The Contractor shall limit operations and storage of material to the area within the Work limit lines shown on Drawings, except as necessary to connect to exiting utilities, shall not encroach on neighboring property, and shall exercise caution to prevent damage to existing structures.

3.5.2 Only materials and equipment, which are to be used directly in the Work, shall be brought to and stored on the Work site by the Contractor. After equipment is no longer required for the Work, it shall be promptly removed from the Work site. Protection of construction materials and equipment stored at the Work site from weather, theft, damage and all other adversity is solely the responsibility of the Contractor.
3.5.3 No project signs shall be erected without the written approval of the Owner's Representative.

3.5.4 The Contractor shall ensure that the Work is at all times performed in a manner that affords reasonable access, both vehicular and pedestrian, to the site of the Work and all adjacent areas. Particular attention shall be paid to access for emergency vehicles, including fire trucks. Wherever there is the possibility of interfering with normal emergency vehicle operations, Contractor shall obtain permission from both campus and municipal emergency response entities prior to limiting any access. The Work shall be performed, to the fullest extent reasonably possible, in such a manner that public areas adjacent to the site of the Work shall be free from all debris, building materials and equipment likely to cause hazardous conditions. Without limitation of any other provision of the Contract Documents, Contractor shall not interfere with the occupancy or beneficial use of (1) any areas and buildings adjacent to the site of the Work or (2) the Work in the event of partial occupancy. Contractor shall assume full responsibility for any damage to the property comprising the Work or to the owner or occupant of any adjacent land or areas resulting from the performance of the Work.

3.5.5 The Contractor shall not permit any workers to use any existing facilities at the Work site, including, without limitation, lavatories, toilets, entrances, and parking areas other than those designated by Owner. The Contractor, Subcontractors of any tier, suppliers and employees shall comply with instructions or regulations of the Owner's Representative governing access to, operation of, and conduct while in or on the premises and shall perform all Work required under the Contract Documents in such a manner as not to unreasonably interrupt or interfere with the conduct of Owner's operations. Any request for Work, a suspension of Work or any other request or directive received by the Contractor from occupants of existing buildings shall be referred to the Owner’s Representative for determination.

3.5.6 The Contractor and the Subcontractor of any tier shall have its’ name, acceptable abbreviation or recognizable logo and the name of the city and state of the mailing address of the principal office of the company, on each motor vehicle and motorized self-propelled piece of equipment which is used in connection with the project. The signs are required on such vehicles during the time the Contractor is working on the project.

3.6 Review of Contract Documents and Field Conditions by Contractor

3.6.1 The Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by the Architect and Owner and shall at once report in writing to the Architect and Owner's Representative any errors, inconsistencies or omissions discovered. If the Contractor performs any construction activity which it knows or should have known involves a recognized error, inconsistency or omission in the Contract Documents without such written notice to the Architect and Owner’s Representative, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

3.6.2 The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents before commencing activities. Errors, inconsistencies or omissions discovered shall be reported in writing to the Architect and Owner’s Representative within twenty-four (24) hours. During the progress of work, Contractor shall verify all field measurements prior to fabrication of building components or equipment, and proceed with the fabrication to meet field conditions. Contractor shall consult all Contract Documents to determine the exact location of all work and verify spatial relationships of all work. Any question concerning said location or spatial relationships shall be submitted to the Owner's Representative. Specific locations for equipment, pipelines, ductwork and other such items of work, where not dimensioned on plans, shall be determined in consultation with Owner's Representative and Architect. Contractor shall be responsible for the proper fitting of the Work in place.

3.6.3 The Contractor shall provide, at the proper time, such material as required for support of the Work. If openings or chases are required, whether shown on Drawings or not, the Contractor shall see they are properly constructed. If required openings or chases are omitted, the Contractor shall cut them at the Contractors own expense, but only as directed by the Architect, through the Owner Representative.

3.6.4 Should the Contract Documents fail to particularly describe materials or goods to be used, it shall be the duty of the Contractor to inquire of the Architect and the Owner’s Representative what is to be used and to supply it at the Contractor’s expense, or else thereafter replace it to the Owner’s Representative’s satisfaction. At a minimum, the Contractor shall provide the quality of materials as generally specified throughout the Contract Documents.

3.7 Cleaning and Removal

3.7.1 The Contractor shall keep the Work site and surrounding areas free from accumulation of waste materials, rubbish, debris, and dirt resulting from the Work and shall
clean the Work site and surrounding areas as requested by the Architect and the Owner's Representative, including mowing of grass greater than 6 inches high. The Contractor shall be responsible for the cost of clean up and removal of debris from premises. The building and premises shall be kept clean, safe, in a workmanlike manner, and in compliance with OSHA standards at all times. At completion of the Work, the Contractor shall remove from and about the Work site tools, construction equipment, machinery, fencing, and surplus materials. Further, at the completion of the work, all dirt, stains, and smudges shall be removed from every part of the building, all glass in doors and windows shall be washed, and entire Work shall be left broom clean in a finished state ready for occupancy. The Contractor shall advise his Subcontractors of any tier of this provision, and the Contractor shall be fully responsible for leaving the premises in a finished state ready for use to the satisfaction of the Owner's Representative. If the Contractor fails to comply with the provisions of this paragraph, the Owner may do so and the cost thereof shall be charged to the Contractor.

3.8 Cutting and Patching

3.8.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly.

3.8.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

3.8.3 If the Work involves renovation and/or alteration of existing improvements, Contractor acknowledges that cutting and patching of the Work is essential for the Work to be successfully completed. Contractor shall perform any cutting, altering, patching, and/or fitting of the Work necessary for the Work and the existing improvements to be fully integrated and to present the visual appearance of an entire, completed, and unified project. In performing any Work which requires cutting or patching, Contractor shall use its best efforts to protect and preserve the visual appearance and aesthetics of the Work to the reasonable satisfaction of both the Owner's Representative and Architect.

3.9 Indemnification

3.9.1 To the fullest extent permitted by law, the Contractor shall defend, indemnify, and hold harmless the Owner, the Architect, Architect’s consultants, and the agents, employees, representatives, insurers and re-insurers of any of the foregoing (hereafter collectively referred to as the “Indemnitees”) from and against claims, damages (including loss of use of the Work itself), punitive damages, penalties and civil fines unless expressly prohibited by law, losses and expenses, including, but not limited to, attorneys’ fees, arising out of or resulting from performance of the Work to the extent caused in whole or in part by negligent acts or omissions or other fault of Contractor, a Subcontractor of any tier, or anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by the negligent acts or omissions or other fault of a party indemnified hereunder. The Contractor’s obligations hereunder are in addition to and shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that the Owner may possess. If one or more of the Indemnitees demand performance by the Contractor of obligations under this paragraph or other provisions of the Contract Documents and if Contractor refuses to assume or perform, or delays in assuming or performing Contractor’s obligations, Contractor shall pay each Indemnitee who has made such demand its respective attorneys’ fees, costs, and other expenses incurred in enforcing this provision. The defense and indemnity required herein shall be a binding obligation upon Contractor whether or not an Indemnitee has made such demand. Even if a defense is successful to a claim or demand for which Contractor is obligated to indemnify the Indemnitees from under this Paragraph, Contractor shall remain liable for all costs of defense.

3.9.2 The indemnity obligations of Contractor under this Section 3.9 shall survive termination of this Contract or final payment thereunder. In the event of any claim or demand made against any party which is entitled to be indemnified hereunder, the Owner may in its sole discretion reserve, return or apply any monies due or to become due the Contractor under the Contract for the purpose of resolving such claims; provided, however, that the Owner may release such funds if the Contractor provides the Owner with reasonable assurance of protection of the Owner’s interests. The Owner shall in its sole discretion determine if such assurances are reasonable. Owner reserves the right to control the defense and settlement of any claim, action or proceeding which Contractor has an obligation to indemnify the Indemnitees against under Paragraph 3.9.1.

3.9.3 In claims against any person or entity indemnified under this Section 3.9 by an employee of the Contractor, a Subcontractor of any tier, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under this Section 3.9 shall not be limited by a limitation on amount or type of
3.9.4 The obligations of the Contractor under Paragraph 3.9.1 shall not extend to the liability of the Architect, his agents or employees, arising out of the preparation and approval of maps, drawings, opinions, reports, surveys, Change Orders, designs, or Specifications.

3.10 Patents
3.10.1 The Contractor shall hold and save harmless the Owner and its officers, agents, servants, and employees from liability of any nature or kind, including cost and expense, for, or on account of, any patented or otherwise protected invention, process, article, or appliance manufactured or used in the performance of the Contract, including its use by the Owner, unless otherwise specifically stipulated in the Contract Documents.

3.10.2 If the Contractor uses any design, device, or material covered by letters patent or copyright, he shall provide for such use by suitable agreement with the Owner of such patented or copyrighted design, device, or material. It is mutually agreed and understood, without exception, that the Contract Sum includes and the Contractor shall pay all royalties, license fees or costs arising from the use of such design, device, or material in any way involved in the Work. The Contractor and/or sureties shall indemnify and save harmless the Owner from any and all claims for infringement by reason of the use of such patented or copyrighted design, device, or material or any trademark or copyright in connection with Work agreed to be performed under this Contract and shall indemnify the Owner for any cost, expense, or damage it may be obligated to pay by reason of such infringement at any time during the prosecution of the Work or after completion of the Work.

3.11 Materials, Labor, and Workmanship
3.11.1 Materials and equipment incorporated into the Work shall strictly conform to the Contract Documents and representations and approved Samples provided by Contractor and shall be of the most suitable grade of their respective kinds for their respective uses, and shall be fit and sufficient for the purpose intended, merchantable, of good new material and workmanship, and free from defect. Workmanship shall be in accordance with the highest standard in the industry and free from defect in strict accordance with the Contract Documents.

3.11.2 Materials and fixtures shall be new and of latest design unless otherwise specified, and shall provide the most efficient operating and maintenance costs to the Owner. All Work shall be performed by competent workers and shall be of best quality.

3.11.3 The Contractor shall carefully examine the Contract Documents and shall be responsible for the proper fitting of his material, equipment, and apparatus into the building.

3.11.4 The Contractor shall base his bid only on the Contract Documents.

3.11.5 Materials and workmanship shall be subject to inspection, examination, and test by the Architect and the Owner's Representative at any and all times during manufacture, installation, and construction of any of them, at places where such manufacture, installation, or construction is performed.

3.11.6 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

3.11.7 Unless otherwise specifically noted, the Contractor shall provide and pay for supervision, labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work.

3.11.8 Substitutions
3.11.8.1 A substitution is a Contractor proposal of an alternate product or method in lieu of has been specified or shown in the Contract Documents, which is not an “or equal” as set forth in Section 3.12.1.

3.11.8.2 Contractor may make a proposal to the Architect and the Owner’s Representative to use substitute products or methods as set forth herein, but the Architect's and the Owner’s Representative’s decision concerning acceptance of a substitute shall be final. The Contractor must do so in writing and setting forth the following:

.1 Full explanation of the proposed substitution and submittal of all supporting data including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and other like information necessary for a complete evaluation of the substitution.

.2 Reasons the substitution is advantageous and necessary, including the benefits to the Owner and the Work in the event the substitution is acceptable.

.3 The adjustment, if any, in the Contract Sum, in the event the substitution is acceptable.

.4 The adjustment, if any, in the time of completion of the Contract and the construction schedule in the event the substitution is acceptable.

.5 An affidavit stating that (a) the proposed substitution conforms to and meets all of the
Contract Documents, except as specifically disclosed and set forth in the affidavit and (b) the Contractor accepts the warranty and correction obligations in connection with the proposed substitution as if originally specified by the Architect. Proposals for substitutions shall be submitted to the Architect and Owner’s Representative in sufficient time to allow the Architect and Owner’s Representative no less than ten (10) working days for review. No substitution will be considered or allowed without the Contractor’s submission of complete substantiating data and information as stated herein.

3.11.8.3 Substitutions may be rejected without explanation in Owner’s sole discretion and will be considered only under one or more of the following conditions:

1. Required for compliance with interpretation of code requirements or insurance regulations then existing;
2. Unavailability of specified products, through no fault of the Contractor;
3. Material delivered fails to comply with the Contract Documents;
4. Subsequent information discloses inability of specified products to perform properly or to fit in designated space;
5. Manufacturer/fabricator refuses to certify or guarantee performance of specified product as required; or
6. When in the judgment of the Owner or the Architect, a substitution would be substantially to the Owner's best interests, in terms of cost, time, or other considerations.

3.11.8.4 Whether or not any proposed substitution is accepted by the Owner or the Architect, the Contractor shall reimburse the Owner for any fees charged by the Architect or other consultants for evaluating each proposed substitute.

3.12 Approved Equal
3.12.1 Whenever in the Contract Documents any article, appliance, device, or material is designated by the name of a manufacturer, vendor, or by any proprietary or trade name, the words "or approved equal," shall automatically follow and shall be implied unless specifically indicated otherwise. The standard products of manufacturers other than those specified will be accepted when, prior to the ordering or use thereof, it is proven to the satisfaction of the Owner's Representative and the Architect they are equal in design, appearance, spare parts availability, strength, durability, usefulness, serviceability, operation cost, maintenance cost, and convenience for the purpose intended. Any general listings of approved manufacturers in any Contract Document shall be for informational purposes only and it shall be the Contractor’s sole responsibility to ensure that any proposed “or equal” complies with the requirements of the Contract Documents.

3.12.2 The Contractor shall submit to Architect and Owner’s Representative a written and full description of the proposed “or equal” including all supporting data, including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and similar information demonstrating that the proposed “or equal” strictly complies with the Contract Documents. The Architect or Owner’s Representative shall take appropriate action with respect to the submission of a proposed “or equal” item. If Contractor fails to submit proposed “or equals” as set forth herein, it shall waive any right to supply such items. The Contract Sum and Contract Time shall not be adjusted as a result of any failure by Contractor to submit proposed “or equals” as provided for herein. All documents submitted in connection with preparing an “or equal” shall be clearly and obviously marked as a proposed “or equal” submission.

3.12.3 No approvals or action taken by the Architect or Owner’s Representative shall relieve Contractor from its obligation to ensure that an “or equal” article, appliance, devise or material strictly complies with the requirements of the Contract Documents. Contractor shall not propose “or equal” items in connection with Shop Drawings or other Submittals, and Contractor acknowledges and agrees that no approvals or action taken by the Architect or Owner’s Representative with respect to Shop Drawings or other Submittals shall constitute approval of any “or equal” item or relieve Contractor from its sole and exclusive responsibility. Any changes required in the details and dimensions indicated in the Contract Documents for the incorporation or installation of any “or equal” item supplied by the Contractor shall be properly made and approved by the Architect at the expense of the Contractor. No ‘or equal’ items will be permitted for components of or extensions to existing systems when, in the opinion of the Architect, the named manufacturer must be provided in order to ensure compatibility with the existing systems, including, but not limited to, mechanical systems, electrical systems, fire alarms, smoke detectors, etc. No action will be taken by the Architect with respect to proposed “or equal” items prior to receipt of bids, unless otherwise noted in the Special Conditions.

3.13 Shop Drawings, Product Data, Samples, and Coordination Drawings/BIM Models
3.13.1 Shop Drawings are drawings, diagrams, schedules and other data specifically prepared for the Work by the Contractor or a Subcontractor, sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.
3.13.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

3.13.3 Samples are physical samples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

3.13.4 Coordination Drawings are drawings for the integration of the Work, including work first shown in detail on shop drawings or product data. Coordination drawings show sequencing and relationship of separate units of work which must interface in a restricted manner to fit in the space provided, or function as indicated. Coordination Drawings are the responsibility of the contractor and are submitted for informational purposes. The Special Conditions will state whether coordination drawings are required. BIM models may be used for coordination in lieu of coordination drawings at the contractor’s discretion, unless required in the Special Conditions. The final coordination drawings/BIM Model will not change the contract documents, unless approved by a fully executed change order describing the specific modifications that are being made to the contract documents.

3.13.5 Shop Drawings, Coordination Drawings/BIM Models, Product Data, Samples and similar submittals (collectively referred to as “Submittals”) are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for which submittals are required the way the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.

3.13.6 The Contractor shall schedule submittal of Shop Drawings and Product Data to the Architect so that no delays will result in delivery of materials and equipment, advising the Architect of priority for checking of Shop Drawings and Product Data, but a minimum of two weeks shall be provided for this purpose. Because time is of the essence in this contract, unless noted otherwise in the Special Conditions or Technical Specifications, all submittals, shop drawings and samples must be submitted as required to maintain the contractor’s plan for proceeding, but must be submitted within 90 days of the Notice To Proceed. If Contractor believes that this milestone is unreasonable for any submittal, Contractor shall request an extension of this milestone, within 60 days of Notice To Proceed, for each submittal that cannot meet the milestone. The request shall contain a reasonable explanation as to why the 90 day milestone is unrealistic, and shall specify a date on which the submittal will be transmitted, for approval by the Owner’s Representative. Failure of the Contractor to comply with this section may result in delays in the submittal approval process and/or charges for expediting approval, both of which will be the responsibility of the Contractor.

3.13.7 The Contractor, at its own expense, shall submit Samples required by the Contract Documents with reasonable promptness as to cause no delay in the Work or the activities of separate contractors and no later than twenty (20) days before materials are required to be ordered for scheduled delivery to the Work site. Samples shall be labeled to designate material or products represented, grade, place of origin, name of producer, name of Contractor and the name and number of the Owner’s project. Quantities of Samples shall be twice the number required for testing so that Architect can return one set of the Samples. Materials delivered before receipt of Architect’s approval may be rejected by Architect and in such event, Contractor shall immediately remove all such materials from the Work site. When requested by Architect or Owner’s Representative, samples of finished masonry and field applied paints and finishes shall be located as directed and shall include sample panels built at the site of approximately twenty (20) square feet each.

3.13.8 The Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect. Such Work shall be in accordance with approved submittals.

3.13.9 By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents such Submittals strictly comply with the requirements of the Contract Documents and that the Contractor has determined and verified field measurements and field construction criteria related thereto, that materials are fit for their intended use and that the fabrication, shipping, handling, storage, assembly and installation of all materials, systems and equipment are in accordance with best practices in the industry and are in strict compliance with any applicable requirements of the Contract Documents. Contractor shall also coordinate each Submittal with other Submittals.

3.13.10 Contractor shall be responsible for the correctness and accuracy of the dimensions, measurements and other information contained in the Submittals.

3.13.11 Each Submittal will bear a stamp or specific indication that the Submittal complies with the Contract Documents and Contractor has satisfied its obligations under the Contract Documents with respect to Contractor’s review and approval of that Submittal. Each Submittal shall bear the signature of the representative of Contractor who approved the Submittal, together with the Contractor’s name, Owner’s name, number of the Project, and the item name and specification section number.

3.13.12 The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data,
Samples or similar submittals. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect's approval thereof. Specifically, but not by way of limitation, Contractor acknowledges that Architect's approval of Shop Drawings shall not relieve Contractor for responsibility for errors and omissions in the Shop Drawings since Contractor is responsible for the correctness of dimensions, details and the design of adequate connections and details contained in the Shop Drawings.

3.13.13 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect on previous Submittals.

3.13.14 The Contractor represents and warrants that all Shop Drawings shall be prepared by persons and entities possessing expertise and experience in the trade for which the Shop Drawing is prepared and, if required by the Architect or applicable Laws, by a licensed engineer or other design professional.

3.14 Record Drawings
3.14.1 The Contractor shall maintain a set of Record Drawings on site in good condition and shall use colored pencils to mark up said set with "record information" in a legible manner to show: (1) bidding addendums, (2) executed change orders, (3) deviations from the Drawings made during construction; (4) details in the Work not previously shown; (5) changes to existing conditions or existing conditions found to differ from those shown on any existing drawings; (6) the actual installed position of equipment, piping, conduits, light switches, electric fixtures, circuiting, ducts, dampers, access panels, control valves, drains, openings, and stub-outs; and (7) such other information as either Owner or Architect may reasonably request. The prints for Record Drawing use will be a set of “blue line” prints provided by Architect to Contractor at the start of construction. Upon Substantial Completion of the Work, Contractor shall deliver all Record Drawings to Owner and Architect for approval. If not approved, Contractor shall make the revisions requested by Architect or Owner’s Representative. Final payment and any retainage shall not be due and owing to Contractor until the final Record Drawings marked by Contractor as required above are delivered to Owner.

3.15 Operating Instructions and Service Manuals
3.15.1 The Contractor shall submit four (4) volumes of operating instructions and service manuals to the Architect before completing 50% of the adjusted contract amount. Payments beyond 50% of the adjusted contract amount may be withheld until all operating instructions and service manuals are received. The operating instructions and service manuals shall contain:

.1 Start-up and Shutdown Procedures: Provide a step-by-step write up of all major equipment. When manufacturer's printed start-up, trouble shooting and shut-down procedures are available, they may be incorporated into the operating manual for reference.

.2 Operating Instructions: Written operating instructions shall be included for the efficient and safe operation of all equipment.

.3 Equipment List: List of all major equipment as installed shall include model number, capacities, flow rate, and name-plate data.

.4 Service Instructions: The Contractor shall be required to provide the following information for all pieces of equipment.

(a) Recommended spare parts including catalog number and name of local suppliers or factory representative.

(b) Belt sizes, types, and lengths.

(c) Wiring diagrams.

.5 Manufacturer's Certificate of Warranty: Manufacturer's certificates of warranty shall be obtained for all major equipment. Warranty shall be obtained for at least one year from the date of Substantial Completion. Where longer period is required by the Contract Documents, the longer period shall govern.

.6 Parts catalogs: For each piece of equipment furnished, a parts catalog or similar document shall be provided which identifies the components by number for replacement ordering.

3.15.2 Submission
.1 Manuals shall be bound into volumes of standard 8 1/2" x 11" hard binders. Large drawings too bulky to be folded into 8 1/2" x 11" shall be separately bound or folded and in brown envelopes, cross-referenced and indexed with the manuals.

.2 The manuals shall identify the Owner’s project name, project number, and include the name and address of the Contractor and major Subcontractors of any tier who were involved with the activity described in that particular manual.

3.16 Taxes
3.16.1 The Contractor shall pay all applicable sales, consumer, use, and similar taxes for the Work which are legally enacted when the bids are received, whether or not yet effective or scheduled to go into effect. However, certain purchases by the Contractor of materials incorporated in or consumed in the Work are exempt from certain sales tax pursuant to RSMo § 144.062. The Contractor shall be issued a Project Tax Exemption Certificate for this Work to obtain the benefits of RSMo § 144.062.

.2 The Contractor shall furnish this certificate to all subcontractors, and any person or entity purchasing materials
for the Work shall present such certificate to all material suppliers as authorization to purchase, on behalf of the Owner, all tangible personal property and materials to be incorporated into or consumed in the Work and no other on a tax-exempt basis. Such suppliers shall provide to the purchasing party invoices bearing the name of the exempt entity and the project identification number. Nothing in this section shall be deemed to exempt from any sales or similar tax the purchase of any construction machinery, equipment or tools used in construction, repairing or remodeling facilities for the Owner. All invoices for all personal property and materials purchased under a Project Tax Exemption Certificate shall be retained by the Contractor for a period of five years and shall be subject to audit by the Director of Revenue.

3.16.3 Any excess resalable tangible personal property or materials which were purchased for the project under this Project Tax Exemption Certificate but which were not incorporated into or consumed in the Work shall either be returned to the supplier for credit or the appropriate sales or use tax on such excess property or materials shall be reported on a return and paid by such purchasing party not later than the due date of the purchasing party’s Missouri sales or use tax return following the month in which it was determined that the materials were not used in the Work.

3.16.4 If it is determined that sales tax is owed by the Contractor on property and materials due to the failure of the Owner to revise the certificate expiration date to cover the applicable date of purchase, Owner shall be liable for the tax owed.

3.16.5 The Owner shall not be responsible for any tax liability due to Contractor’s neglect to make timely orders, payments, etc. or Contractor’s misuse of the Project Tax Exemption Certificate. Contractor represents that the Project Tax Exemption Certificate shall be used in accordance with RSMo § 144.062 and the terms of the Project Tax Exemption Certificate. Contractor shall indemnify the Owner for any loss or expense, including but not limited to, reasonable attorneys’ fees, arising out of Contractor’s use of the Project Tax Exemption Certificate.

3.17 Contractor’s Construction Schedules
3.17.1 The Contractor, within fifteen (15) days after the issuance of the Notice to Proceed, shall prepare and submit for the Owner’s and Architect’s information Contractor’s construction schedule for the Work and shall set forth interim dates for completion of various components of the Work and Work Milestone Dates as defined herein. The schedule shall not exceed time limits current under the Contract Documents, shall be revised on a monthly basis or as requested by the Owner’s Representative as required by the conditions of the Work, and shall provide for expeditious and practicable execution of the Work. The Contractor shall conform to the most recent schedule.

3.17.2 The construction schedule shall be in a detailed format satisfactory to the Owner’s Representative and the Architect and in accordance with the detailed schedule requirements set forth in this document and the Special Conditions. If the Owner’s Representative or Architect has a reasonable objection to the schedule submitted by Contractor, the construction schedule shall be promptly revised by the Contractor. The Contractor shall monitor the progress of the Work for conformance with the requirements of the construction schedule and shall promptly advise the Owner of any delays or potential delays.

3.17.3 As time is of the essence to this contract, the University expects that the Contractor will take all necessary steps to insure that the project construction schedule shall be prepared in accordance with the specific requirements of the Special Conditions to this contract. At a minimum, contractor shall comply with the following:

1. The schedule shall be prepared using Primavera P3, Oracle P6, Microsoft Project or other software acceptable to the Owner’s Representative.
2. The schedule shall be prepared and maintained in CPM format, in accordance with Construction CPM Scheduling, published by the Associated General Contractors of American (AGC).
3. Prior to submittal to the Owner’s Representative for review, Contractor shall obtain full buy-in to the schedule from all major subcontractors, in writing if so requested by Owner’s Representative.
4. Schedule shall be updated, in accordance with Construction CPM Scheduling, published by the AGC, on a monthly basis at minimum, prior to, and submitted with, the monthly pay application or as requested by the Owner’s Representative.
5. Along with the update the Contractor shall submit a narrative report addressing all changes, delays and impacts, including weather to the schedule during the last month, and explain how the end date has been impacted by same.
6. The submission of the updated certifies that all delays and impacts that have occurred on or to the project during the previous month have been factored into the update and are fully integrated into the schedule and the projected completion date.

Failure to comply with any of these requirements will be considered a material breach of this contract. See Special Conditions for detailed scheduling requirements.

3.17.4 In the event the Owner’s Representative or Architect determines that the performance of the Work, as of a Milestone Date, has not progressed or reached the level of completion required by the Contract Documents, the Owner shall have the

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right to order the Contractor to take corrective measures necessary to expedite the progress of construction, including, without limitation, (1) working additional shifts or overtime, (2) supplying additional manpower, equipment, facilities, (3) expediting delivery of materials, and (4) other similar measures (hereinafter referred to collectively as Extraordinary Measures). Such Extraordinary Measures shall continue until the progress of the Work complies with the stage of completion required by the Contract Documents. The Owner's right to require Extraordinary Measures is solely for the purpose of ensuring the Contractor's compliance with the construction schedule. The Contractor shall not be entitled to an adjustment in the Contract Sum concerning Extraordinary Measures required by the Owner under or pursuant to this Paragraph 3.17.3. The Owner may exercise the rights furnished the Owner under or pursuant to this Paragraph 3.17.3 as frequently as the Owner deems necessary to ensure that the Contractor's performance of the Work will comply with any Milestone Date or completion date set forth in the Contract Documents.

ARTICLE 4
ADMINISTRATION OF THE CONTRACT

4.1 Rights of the Owner

4.1.1 The Owner's Representative will administer the Construction Contract. The Architect will assist the Owner's Representative with the administration of the Contract as indicated in these Contract Documents.

4.1.2 If, in the judgment of the Owner's Representative, it becomes necessary to accelerate the work, the Contractor, when directed by the Owner's Representative in writing, shall cease work at any point and transfer its workers to such point or points and execute such portions of the work as may be required to enable others to hasten and properly engage and carry out the work, all as directed by the Owner's Representative. The additional cost of accelerating the work, if any, will be borne by the Owner, unless the Contractor's work progress is behind schedule as shown on the most recent progress schedule.

4.1.3 If the Contractor refuses, for any reason, to proceed with what the Owner believes to be contract work, the Owner may issue a Construction Directive, directing the Contractor to proceed. Contractor shall be obligated to promptly proceed with this work. If Contractor feels that it is entitled to additional compensation for this work, it may file a claim for additional compensation and/or time, in accordance with 4.4 of this document.

4.1.4 The Owner's Representative, may, by written notice, require a Contractor to remove from involvement with the Work, any of Contractor's personnel or the personnel of its Subcontractors of any tier whom the Owner's Representative may deem abusive, incompetent, careless, or a hindrance to proper and timely execution of the Work. The Contractor shall comply with such notice promptly, but without detriment to the Work or its progress.

4.1.5 The Owner's Representative will schedule Work status meetings that shall be attended by representatives of the Contractor and appropriate Subcontractors of any tier. Material suppliers shall attend status meetings if required by the Owner's Representative. These meetings shall include preconstruction meetings.

4.1.6 The Owner does not allow smoking on University property.

4.2 Rights of the Architect

4.2.1 The Architect will interpret requirements of the Contract Documents with respect to the quality, quantity and other technical requirements of the Work itself within a reasonable time after written request of the Contractor. Contractor shall provide Owner’s Representative a copy of such written request.

4.3 Review of the Work

4.3.1 The Architect and the Owner's Representative shall, at all times, have access to the Work; and the Contractor shall provide proper and safe facilities for such access.

4.3.2 The Owner’s Representative shall have authority to reject Work that does not strictly comply with the requirements of the Contract Documents. Whenever the Owner’s Representative considers it necessary or advisable for implementation of the intent of the Contract Documents, Owner’s Representative shall have the authority to require additional inspection or testing of the Work, whether or not such Work is fabricated, installed or completed.

4.3.3 The fact that the Architect or the Owner's Representative observed, or failed to observe, faulty Work, or Work done which is not in accordance with the Contract Documents, regardless of whether or not the Owner has released final payment, shall not relieve the Contractor from responsibility for all damages and additional costs of the Owner as a result of defective or faulty Work.

4.4 Claims

4.4.1 A Claim is a demand or assertion by Contractor seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of time or any other relief with respect to the terms of the Contract. The term "Claim(s)" also includes demands and assertions of Contractor arising out of or relating to the Contract Documents, including Claims based upon breach of contract, mistake, misrepresentation, or other cause for Contract Modification or
Claims must be made by written notice. Contractor shall have the responsibility to substantiate Claims.

4.4.2 Claims by Contractor must be made promptly, and no later than within fourteen (14) days after occurrence of the event giving rise to such Claim. Claims must be made by written notice. Such notice shall include a detailed statement setting forth all reasons for the Claim and the amount of additional money and additional time claimed by Contractor. The notice of Claims shall also strictly comply with all other provisions of the Contract Documents. Contractor shall not be entitled to rely upon any grounds or basis for additional money on additional time not specifically set forth in the notice of Claim. All Claims not made in the manner provided herein shall be deemed waived and of no effect. Contractor shall furnish the Owner and Architect such timely written notice of any Claim provided for herein, including, without limitation, those in connection with alleged concealed or unknown conditions, and shall cooperate with the Owner and Architect in any effort to mitigate the alleged or potential damages, delay or other adverse consequences arising out of the condition which is the cause of such a Claim.

4.4.3 Pending final resolution of a Claim, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments that are not in dispute in accordance with the Contract Documents.

4.5 Claims for Concealed or Unknown Conditions

4.5.1 If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents, or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the Contractor shall be given to the Owner's Representative promptly before conditions are disturbed, and in no event later than three (3) days after first observance of the conditions. The Owner's Representative will promptly investigate such conditions. If such conditions differ materially, as provided for above and cause an increase or decrease in the Contractor’s cost, or time, required for performance of the Work, an equitable adjustment in the Contract sum or Contract Time, or both, shall be made, subject to the provisions and restrictions set for herein. If the Owner's Representative determines that the conditions at the site are not materially different from those indicated in the Contract Documents, and that no change in the terms of the Contract is justified, the Owner's Representative will notify the Contractor in writing. If the Contractor disputes the finding of the Owner’s Representative that no change in the terms of the Contract terms is justified, Contractor shall proceed with the Work, taking whatever steps are necessary to overcome or correct such conditions so that Contractor can proceed in a timely manner. The Contractor may have the right to file a Claim in accordance with the Contract Documents.

4.5.2 It is expressly agreed that no adjustment in the Contract Time or Contract Sum shall be permitted, however, in connection with a concealed or unknown condition which does not differ materially from those conditions disclosed or which reasonably should have been disclosed by the Contractor’s (1) prior inspections, tests, reviews and preconstruction investigations for the Project, or (2) inspections, tests, reviews and preconstruction inspections which the Contractor had the opportunity to make or should have performed in connection with the Project.

4.6 Claim for Additional Cost

4.6.1 If the Contractor makes a Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. In addition to all other requirements for notice of a Claim, said notice shall detail and itemize the amount of all Claims and shall contain sufficient data to permit evaluation of same by Owner.

4.7 Claims for Additional Time

4.7.1 If the Contractor makes a Claim for an increase in the Contract Time, written notice as provided herein shall be given in addition to all other requirements for notice of a Claim, Contractor shall include an estimate of the probable effect of delay upon the progress of the Work, utilizing a CPM Time Impact Schedule Analysis, (TIA) as defined in the AGC Scheduling Manual. In the case of a continuing delay, only one Claim is necessary.

1 Time extensions will be considered for excusable delays only. That is, delays that are beyond the control and/or contractual responsibility of the contractor.

4.7.2 If weather days are the basis for a Claim for additional time, such Claim shall be documented by the Contractor by data acceptable to the Owner's Representative substantiating that weather conditions for the period of time in question, had an adverse effect on the critical path of the scheduled construction. Weather days shall be defined as days on which critical path work cannot proceed due to weather conditions (including but not limited to rain, snow, etc.), in excess of the number of days shown on the Anticipated Weather Day schedule in the Special Conditions. To be considered a weather day, at least four hours must be lost due to the weather conditions on a critical path scope item for that day. Weather days and Anticipated weather days listed in the Special Conditions shall only apply to Monday through Friday. A weather day claim cannot be made for Saturdays, Sundays, New Year’s Day, Martin Luther King Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the day after Thanksgiving Day and
4.7 Resolution of Claims and Disputes
4.7.1 The Owner's Representative will review Claims and take one or more of the following preliminary actions within ten days of receipt of a Claim: (1) request additional supporting data from the Contractor, (2) reject the Claim in whole or in part, (3) approve the Claim, or (4) suggest a compromise.

4.7.2 If a Claim has not been resolved, the Contractor shall, within ten days after the Owner's Representative's preliminary response, take one or more of the following actions: (1) submit additional supporting data requested, (2) modify the initial Claim, or (3) notify the Owner's Representative that the initial Claim stands.

4.8 Resolution of Claims and Disputes
4.8.1 If a Claim has not been resolved pursuant to the procedures set forth in the Contract Documents except with respect to Owner's Representative's decision on matters relating to aesthetic effect, and except for claims which have been waived by the making or acceptance of final payment, or the Contractor's acceptance of payments in full for changes in work may be submitted to administrative review as provided in this section. All requests for administrative review shall be made in writing.

4.8.2 Upon written request from the Contractor, the Owner's Review Administrator authorized by the Campus Contracting Officer will convene a review meeting between the Contractor and Owner's Representative within fifteen (15) days of receipt of such written request. The Contractor and Owner's Representative will be allowed to present written documentation with respect to the claim(s) before or during the meeting. The Owner and Contractor's Representative will be allowed to present the testimony of any knowledgeable person regarding the claim at the review meeting. The Owner's Review Administrator will issue a written summary of the review meeting and decision to resolve the Claim within fifteen (15) days. If the Contractor is in agreement with the decision the Contractor shall notify the Owner's Review Administrator in writing within five (5) days, and appropriate documentation will be signed by the parties to resolve the Claim.

4.8.3 If the Contractor is not in agreement with the proposal of the Owner's Review Administrator as to the resolution of the claim, the Contractor may file a written appeal with the UM System Contracting Officer,
University of Missouri, 109 Old Alumni Centers, University of Missouri, Columbia, Missouri 65211] within fifteen (15) days after receipt of the Owner’s Review Administrator’s proposal. The UM System Contracting Officer will call a meeting of the Contractor, the Owner’s Representative, and the Owner’s Review Administrator by written notice, within thirty (30) days after receipt of the Contractor's written appeal. The Owner’s Review Administrator shall provide the UM System Contracting Officer with a copy of the written decision and summary of the review meeting, the Contractor's corrections or comments regarding the summary of the review meeting, and any written documentation presented by the Contractor and the Owner’s Representative at the initial review meeting. The parties may present further documentation and/or present the testimony of any knowledgeable person regarding the claim at the meeting called by the UM System Contracting Officer.

4.9.4 The UM System Contracting Officer will issue a written decision to resolve the claim within fifteen (15) days after the meeting. If the Contractor is in agreement with the UM System Contracting Officer's proposal, the Contractor shall notify the UM System Contracting Officer in writing within five (5) days, and the Contractor and the Owner shall sign appropriate documents. The issuance of the UM System Contracting Officer's written proposal shall conclude the administrative review process even if the Contractor is not in agreement. However, proposals and any opinions expressed in such proposals issued under this section will not be binding on the Contractor nor will the decisions or any opinions expressed be admissible in any legal actions arising from the Claim and will not be deemed to remove any right or remedy of the Contractor as may otherwise exist by virtue of Contract Documents or law. Contractor and Owner agree that the Missouri Circuit Court for the County where the Work is located shall have exclusive jurisdiction to determine all issues between them. Contractor agrees not to file any complaint, petition, lawsuit or legal proceeding against Owner except with such Missouri Circuit Court.

ARTICLE 5
SUBCONTRACTORS

5.1 Award of Subcontracts
5.1.1 Pursuant to Article 9, the Contractor shall furnish the Owner and the Architect, in writing, with the name, and trade for each Subcontractor and the names of all persons or entities proposed as manufacturers of products, materials and equipment identified in the Contract Documents and where applicable, the name of the installing contractor. The Owner’s Representative will reply to the Contractor in writing if the Owner has reasonable objection to any such proposed person or entity. The Contractor shall not contract with a proposed person or entity to whom the Owner has made reasonable and timely objection.

5.1.2 The Contractor may request to change a subcontractor. Any such request shall be made in writing to the Owner’s Representative. The Contractor shall not change a Subcontractor, person, or entity previously disclosed if the Owner makes reasonable objection to such change.

5.1.3 The Contractor shall be responsible to the Owner for acts, defaults, and omissions of its Subcontractors of any tier.

5.2 Subcontractual Relations
5.2.1 By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor of any tier, to the extent of the Work to be performed by the Subcontractor of any tier, to be bound to the Contractor by terms of the Contract Documents and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Documents, assumes toward the Owner and the Architect. Each subcontract agreement of any tier shall preserve and protect the rights of the Owner and the Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor of any tier so that subcontracting thereof will not prejudice such rights and shall allow to the Subcontractor of any tier, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with its sub-subcontractors. The Contractor shall make available to each proposed Subcontractor of any tier, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor of any tier shall be bound Subcontractors of any tier shall similarly make copies of applicable portions of such documents available to their respective proposed Subcontractors of any tier.

5.2.2 All agreements between the Contractor and a Subcontractor or supplier shall contain provisions whereby Subcontractor or supplier waives all rights against the Owner, contractor, Owner’s representative, Architect and all other additional insureds for all losses and damages caused by, arising out of, or resulting from any of the perils covered by property or builders risk insurance coverage required of the Contractor in the Contract Documents. If Contractor fails to include said provisions in all subcontracts, Contractor shall indemnify, defend and hold all the above entities harmless in the event of any legal action by Subcontractor or supplier. If insureds on any such policies require separate
waiver forms to be signed by any Subcontractors of any tier or suppliers, Contractor shall obtain the same.

5.3 Contingent Assignment of Subcontract
5.3.1 No assignment by the Contractor of any amount or any part of the Contract or of the funds to be received thereunder will be recognized unless such assignment has had the written approval of the Owner, and the surety has been given due notice of such assignment and has furnished written consent hereto. In addition to the usual recitals in assignment Contracts, the following language must be set forth: "it is agreed that the funds to be paid to the assignee under this assignment are subject to performance by the Contractor of the contract and to claims and to liens for services rendered or materials supplied for the performance of the Work called for in said contract in favor of all persons, firms or corporations rendering such services or supplying such materials.

ARTICLE 6
SEPARATE CONTRACTS AND COOPERATION
6.1 The Owner reserves the right to let other contracts in connection with the Work.

6.2 It shall be the duty of each Contractor to whom Work may be awarded, as well as all Subcontractors of any tier employed by them, to communicate immediately with each other in order to schedule Work, locate storage facilities, etc., in a manner that will permit all Contractors to work in harmony in order that Work may be completed in the manner and within the time specified in the Contract Documents.

6.3 No Contractor shall delay another Contractor by neglecting to perform his work at the proper time. Each Contractor shall be required to coordinate his work with other Contractors to afford others reasonable opportunity for execution of their work. Any costs caused by defective or ill-timed work, including actual damages and liquidated damages for delay, if applicable, shall be borne by the Contractor responsible therefor.

6.4 Each Contractor shall be responsible for damage to Owner's or other Contractor's property done by him or persons in his employ, through his or their fault or negligence. If any Contractor shall cause damage to any other Contractor, the Contractor causing such damage shall upon notice of any claim, settle with such Contractor.

6.5 The Contractor shall not claim from the Owner money damages or extra compensation under this Contract when delayed in initiating or completing his performance hereunder, when the delay is caused by labor disputes, acts of God, or the failure of any other Contractor to complete his performance under any Contract with the Owner, where any such cause is beyond the Owner's reasonable control.

6.6 Progress schedule of the Contractor for the Work shall be submitted to other Contractors as necessary to permit coordinating their progress schedules.

6.7 If Contractors or Subcontractors of any tier refuse to cooperate with the instructions and reasonable requests of other contractors performing work for the Owner under separate contract, in the overall coordinating of the Work, the Owner's Representative may take such appropriate action and issue such instructions as in his judgement may be required to avoid unnecessary and unwarranted delay.

ARTICLE 7
CHANGES IN THE WORK
7.1 CHANGE ORDERS
7.1.1 A change order is a written instrument prepared by the Owner and signed by the Owner and Contractor formalizing their agreement on the following:
.1 a change in the Work
.2 the amount of an adjustment, if any, in the Contract amount
.3 an adjustment, if any, in the Contract time

7.1.2 The Owner may at any time, order additions, deletions, or revisions in the Work by a Change Order or a Construction Change Directive. Such Change Order or Construction Change Directive shall not invalidate the Contract and requires no notice to the surety. Upon receipt of any such document, or written authorization from the Owner’s Representative directing the Contractor to proceed pending receipt of the document, Contractor shall promptly proceed with the Work involved in accordance with the terms set forth therein.

7.1.3 Until such time as the change order is formalized and signed by both the Owner and the Contractor it shall be considered a Change Order Request.

7.1.4 The amount of adjustment in the contract price for authorized Change Orders will be agreed upon before such Change Orders becomes effective and will be determined as follows:
.1 By a lump sum proposal from the Contractor and the Subcontractors of any tier, including overhead and profit.
.2 By a time and material basis with or without a specified maximum. The Contractor shall submit to the Owner’s Representative itemized time and material sheets depicting labor, materials, equipment utilized in completing the Work on a daily basis for the Owner's Representative approval. If this pricing option is utilized, the
Contractor may be required to submit weekly reports summarizing costs to date on time and material change orders not yet finalized.

By unit prices contained in the Contractor's original bid and incorporated in the Construction Contract or subsequently agreed upon. Such unit prices contained in the Contractor's original proposal are understood to include the Contractor's overhead and profit. If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are so changed in a proposed Change Order that application of such unit prices to quantities of the Work proposed will cause substantial inequity to the Owner or to the Contractor, the applicable unit prices shall be equitably adjusted.

7.1.5 The Contractor shall submit all fully documented change order requests with corresponding back-up documentation within the time requested by the Owner but no later than fourteen (14) working days following 1.) the Owner's request for change order pricing in the case of a lump sum; or 2.) the completion of unit price or time and material work.

7.1.6 The Contractor shall submit change order requests in sufficient detail to allow evaluation by the Owner. Such requests shall be fully itemized by units of labor, material and equipment and overhead and profit. Such breakdowns shall be itemized as follows:

1. Labor: The Contractor's proposal shall include breakdowns by labor, by trade, indicating number of hours and cost per hour for each Subcontractor as applicable. Such breakdowns shall only include employees in the direct employ of Contractor or Subcontractors in the performance of the Work. Such employees shall only include laborers at the site, mechanics, craftsmen and foremen. Payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor or Subcontractors. Any item or expense outside of these categories is not allowed. The expense of performing Work after regular working hours, on Saturdays, Sundays or legal holidays shall not be included in the above, unless approved in writing and in advance by Owner.

2. Material, supplies, consumables and equipment to be incorporated into the Work at actual invoice cost to the Contractor or Subcontractors; breakdowns showing all material, installed equipment and consumables fully itemized with number of units installed and cost per unit extended. Any singular item or items in aggregate greater than one thousand dollars ($1,000) in cost shall be supported with supplier invoices at the request of the Owner’s Representative. Normal hand tools are not compensable.

3. Equipment: Breakdown for required equipment shall itemize (at a minimum) delivery / pick-up charge, hourly rate and hours used. Operator hours and rate shall not be included in the equipment breakdown. Contractor must use the most cost effective equipment available in the area and should not exceed the rates listed in the Rental Rate Blue Book for Construction Equipment (Blue Book). Contractor shall submit documentation for the Blue Book to support the rate being requested.

7.2 Construction Change Directive

7.2.1 A construction change directive is a written order prepared and signed by the Owner, issued with supporting documents prepared by the Architect (if applicable), directing a change in the Work prior to agreement on adjustment of the Contract amount or Contract time, or both. A Construction Change Directive shall be used in the absence of complete agreement between the Owner and Contractor on the terms of a change order. If the Construction Change Directive allows an adjustment of the contract amount or time, such adjustment amount shall be based on one of the following methods:

1. A lump sum agreement, properly itemized and supported by substantiating documents of sufficient detail to allow evaluation.

2. By unit prices contained in the Contractor's original proposal and incorporated in the Construction Contract or subsequently agreed upon.

3. A method agreed to by both the Owner and the contractor with a mutually agreeable fee for overhead and profit.

4. In the absence of an agreement between the Owner and the Contractor on the method of establishing an adjustment of the contract amount, the Owner, with the assistance of the architect, shall determine the adjustment amount on the basis of expenditures by the Contractor for labor, materials, equipment and other costs consistent with other provisions of the Contract. The contractor shall keep and submit to the Owner an itemized accounting of all cost components, either expended or saved, while performing the Work covered under the Construction Change Directive.

7.2.2 Upon receipt of a Construction Change Directive, Contractor shall promptly proceed with the change in the Work involved and advise Owner of Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum, Contract Time or both.

7.2.3 A Construction Change Directive signed by Contractor indicates the agreement of the Contractor therewith, including adjustment in Contract Sum and Contract Time or the method for determining them.
Such agreement shall be effective immediately and shall be recorded as a Change Order.

7.3 Overhead and Profit
7.3.1 Overhead and Profit on Change Orders shall be applied as follows:
.1 The overhead and profit charged by the Contractor and Subcontractors shall be considered to include, but not limited to, job site office and clerical expense, normal hand tools, incidental job supervision, field supervision, payroll costs and other compensation for project manager, officers, executives, principals, general managers, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, time-keepers, and other personnel employed whether at the site or in principal or a branch office for general superintendent and administration of the Work.
.2 The percentages for overhead and profit charged on Change Orders shall be negotiated and may vary according to the nature, extent, and complexity of the Work involved but in no case shall exceed the following:
  15% To the Contractor or the Subcontractor of any tier for Work performed with their respective forces or materials purchased
  5% To the Contractor on Work performed by other than his forces
  5% To first tier Subcontractor on Work performed by his Subcontractor
.3 The Contractor will be allowed to add 2% for the cost of bonding and insurance to their cost of work. This 2% shall be allowed on the total cost of the added work, including overhead and profit.
.4 Not more than three mark-ups, not to exceed individual maximums shown above, shall be allowed regardless of the number of tier subcontractors. Overhead and profit shall be shown separately for each subcontractor of any tier and the Contractor.
.5 On proposals covering both increases and decreases in the amount of the Contract, the application of overhead and profit shall be on the net change in direct cost for the Contractor or Subcontractor of any tier performing the Work.
.6 The percentages for overhead and profit credit to the Owner on Change Orders that are strictly decreases in the quantity of work or materials shall be negotiated and may vary according to the nature, extent, and complexity of the Work involved, but shall not be less than the following:
  Overhead and Profit
  7.5% Credit to the Owner from the Contractor or Subcontractor of any tier for Work performed with their respective forces or materials purchased
  2.5% Credit to the Owner from the Contractor on Work performed by other than his forces
  2.5% Credit to the Owner from the first tier Subcontractor on Work performed by his Subcontractor of any tier

7.4 Extended General Conditions
7.4.1 The Contractor acknowledges that the percentage mark-up allowed on change orders for overhead and profit cover the Contractor’s cost of administering and executing the Work, inclusive of change orders that increase the contract time. Contractor further acknowledges that no compensation beyond the specified mark-up percentages for extended overhead shall be due or payable as a result of an increase in the Contract Time.

7.4.2 The Owner may reimburse the Contractor for extended overhead if an extension of the Contract Time is granted by the Owner, in accordance with Article 4.7.1 and the Owner determines that the extension of the Contract Time creates an inequitable condition for the Contractor. If these conditions are determined by the Owner to exist the Contractor may be reimbursed by unit prices contained in the Contractor’s original bid and incorporated in the Construction Contract or by unit prices subsequently agreed upon.

7.4.3 If unit prices are subsequently agreed upon, the Contractor’s compensation shall be limited as follows:
.1 For the portion of the direct payroll cost of the Contractor’s project manager expended in completing the Work and the direct payroll cost of other onsite administrative staff not included in Article 7.3.1. Direct payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers’ or workmen’s compensation insurance and other customary and legally required taxes paid by the Contractor;
.2 Cost of Contractor’s temporary office, including temporary office utilities expense;
.3 Cost of temporary utilities required in the performance of the work;
.4 Profit not to exceed 5% of the total extended overhead direct costs;

7.4.4 All costs not falling into one of these categories and costs of the Contractors staff not employed onsite are not allowed.

7.5 Emergency Work
7.5.1 If, during the course of the Work, the Owner has need to engage the Contractor in emergency work, whether related to the Work or not, the Contractor shall immediately
proceed with the emergency work as directed by the Owner under the applicable provisions of the contract. In so doing, Contractor agrees that all provisions of the contract remain in full force and effect and the schedule for the Work is not impacted in any way unless explicitly agreed to in writing by the Owner.

ARTICLE 8
TIME

8.1 Progress and Completion
8.1.1 Contractor acknowledges and agrees that time is of the essence of this Contract

8.1.2 Contract Time is the period of time set forth in the Contract for Construction required for Substantial Completion and Final Completion of the entire Work or portions of the Work as defined in the Contract Documents. Time limits stated in the Contract Documents are of the essence of the Contract. The Contract Time may only be changed by a Change Order. By executing the Contract, the Contractor confirms that the Contract Time is a sufficient period for performing the Work in its entirety.

8.1.3 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or anywhere prior to the effective date of insurance and bonds required by Article 11 to be furnished by the Contractor.

8.1.4 The Contractor shall proceed expeditiously and diligently with adequate forces and shall achieve Substantial Completion and Final Completion within the time specified in the Contract Documents.

8.2 Delay in Completion
8.2.1 The Contractor shall be liable for all of the Owner’s damages for delay in achieving Substantial Completion and/or Final Completion of the entire Work or portions of Work as set forth in the Contract Documents within the Contract Time unless liquidated damages are specifically provided for in the Contract Documents. If liquidated damages are specifically provided for in the Contract for Construction, Contractor shall be liable for such liquidated damages as set forth in Paragraph 8.3

8.2.2 All time limits stated in the Contract are of the essence of the Contract. However, if the Contractor is delayed at any time in the progress of the Work by any act or neglect of the Owner or by the Owner's Representative, by changes ordered in the Work, by strikes, lockouts, abnormal weather conditions, jurisdictional disputes, or any other causes beyond the Contractor's reasonable control which the Owner's Representative determines may justify delay then, upon submission of the Time Impact Schedule Analysis (TIA) called out in Section 4.7 of these General Conditions, the Contract Time may be extended for a reasonable time to the extent such delay will prevent Contractor from achieving Substantial Completion and/or Final Completion within the Contract Time and if performance of the Work is not, was not or would not have been delayed by any other cause for which the Contractor is not entitled to an extension in the Contract Time under the Contract Documents. It shall be a condition precedent to any adjustment of the Contract Time that Contractor provide the Owner's Representative with written notice of the cause of delay within seven (7) days from the occurrence of the event or condition which caused the claimed delay. Written notices hereunder shall be in accordance with the applicable provisions of Section 4.7.

8.2.3 The Contractor further acknowledges and agrees that adjustments in the Contract Time will be permitted for a delay only to the extent such delay (1) is not caused, or could not have been anticipated, by the Contractor, (2) could not be limited or avoided by the Contractor's timely notice to the Owner of the delay, (3) prevents Contractor from completing its Work by the Contract Time, and (4) is of a duration not less than one (1) day. Delays attributable to and within the control of a Subcontractor or supplier shall not justify an extension of the Contract Time.

8.2.4 Notwithstanding anything to the contrary in the Contract Documents, except as otherwise noted in these General Conditions, an extension in the Contract Time, to the extent permitted under this Article, shall be the sole remedy of the Contractor for any (1) delay in the commencement, prosecution or completion of the Work, (2) hindrance or obstruction in the performance of the Work, (3) loss of productivity, or (4) other similar claims due to or caused by any events beyond the control of both the Owner and Contractor. In no event shall the Contractor be entitled to any compensation or recovery of any damages or any portion of damages resulting from delays caused by or within the control of Contractor or by acts or omissions of Contractor or its Subcontractors of any tier or delays beyond the control of both Owner and Contractor. If the Contractor contends that delay, hindrance, obstruction or other adverse condition results from acts or omissions of the Owner, the Owner's Representative or the Architect, Contractor shall promptly provide written notice to the Owner. Contractor shall only be entitled to an adjustment in the Contract Sum to the extent that such acts or omissions continue after the Contractor's written notice to the Owner of such acts or omissions. The Owner's exercise of any of its rights or remedies under the Contract Documents (including, without limitation, ordering changes in the Work, or directing suspension, rescheduling or correction of the Work) regardless of the extent or frequency of the Owner's exercise of such rights or remedies, shall not be the basis of any Claim for an increase in the Contract Sum or Contract
Time. In the event Contractor is entitled to an adjustment in the Contract Sum for any delay, hindrance, obstruction or other adverse condition caused by the acts or omissions of the Owner, the Owner’s Representative or the Architect, Contractor shall only be entitled to its actual direct costs caused thereby and Contractor shall not be entitled to and waives any right to special, indirect, or consequential damages including loss of profits, loss of savings or revenues, loss of anticipated profits, labor inefficiencies, idle equipment, home office overhead, and similar type of damages.

8.2.5 If the Contractor submits a progress report or any construction schedule indicating, or otherwise expressing an intention to achieve completion of the Work prior to any completion date required by the Contract Documents or expiration of the Contract Time, no liability of the Owner to the Contractor for any failure of the Contractor to so complete the Work shall be created or implied. Further, the Contractor acknowledges and agrees that even if Contractor intends or is able to complete the Work prior to the Contract Time, it shall assert no Claim and the Owner shall not be liable to Contractor for any failure of the Contractor, regardless of the cause of the failure, to complete the Work prior to the Contract Time.

8.3 Liquidated Damages

8.3.1 If Liquidated Damages are prescribed on the Bid Form and Special Conditions in the Contract Documents, the Owner may deduct from the Contract Sum and retain as Liquidated Damages, and not as penalty or forfeiture, the sum stipulated in the Contract Documents for each calendar day after the date specified for completion of the Work that the entire Work is not substantially complete and/or finally complete.

8.3.2 The Owner’s Representative shall establish the date of Substantial completion and the date of Final Completion of the Work which shall be conclusive and binding on the Owner and Contractor for the purpose of determining whether or not Liquidated Damages shall be assessed under terms hereof and the sum total amount due.

8.3.3 Liquidated Damages or any matter related thereto shall not relieve the Contractor or his surety of any responsibility or obligation under this Contract.

ARTICLE 9 PAYMENTS AND COMPLETION

9.1 Commencement, Prosecution, and Completion

9.1.1 The Contractor shall commence Work within five (5) days upon the date of a “Notice to Proceed” from the Owner or the date fixed in the Notice to Proceed. Contractor shall prosecute the Work with faithfulness and diligence, and the Contractor shall complete the Work within the Contract Time set forth in the Contract Documents.

9.1.2 The Owner will prepare and forward three (3) copies of the Contract and Performance Bond to the bidder to whom the contract for the Work is awarded and such bidder shall return two (2) properly executed prescribed copies of the Contract and Bond to the Owner.

9.1.3 The construction period, when specified in consecutive calendar days, shall begin when the Contractor receives notice requesting the instruments listed in below. Before the Owner will issue Notice to Proceed to permit the Contractor to begin Work, the Owner shall have received the following instruments, properly executed as described in the Contract Documents. The documents below shall have been received by the Owner within fifteen (15) days after receipt of request for documents:

.1 Contract
.2 Bond (See Article 11)
.3 Insurance (See Article 11)
.4 List of Subcontractors of any tier
.5 Affirmative Action Plan (see Article 13.4)

9.1.4 In the event Contractor fails to provide Owner such documents, Contractor may not enter upon the site of the Work until such documents are provided. The date the Contractor is required to commence and complete the Work shall not be affected by the Owner denying Contractor access to the site as a result of Contractor’s failure to provide such documents and Contractor shall not be entitled to an adjustment of the Contract Time or Contract sum as a result of its failure to comply with the provisions of this Paragraph

9.1.5 Contracts executed by partnerships shall be signed by all general partners of the partnership. Contracts signed by corporations shall be signed by the President or Vice President and the Secretary or Assistant Secretary. In case the Assistant Secretary or Vice President signs, it shall be so indicated by writing the words "Asst." or "Vice" in front of the words "Secretary" and "President". The corporate seal of the corporation shall be affixed. For all other types of entities, the Contractor and the person signing the Contract on behalf of Contractor represent and warrant that the person signing the Contract has the legal authority to bind Contractor to the Contract.

9.1.6 Any successful bidder which is a corporation organized in a state other than Missouri or any bidder doing business in the State of Missouri under a fictitious name shall furnish, at no cost to the Owner, no later than the time at which the executed Contract for Construction, the Payment Bond, and the Performance Bond are returned, a properly certified copy of its current Certificate of Authority and License to do business in the State of Missouri. No contract will be executed by the Owner until such certificate is furnished by the bidder, unless there already is on file with
the Owner a current certificate, in which event, no additional certificate will be required during the period of time for which such current certificate remains in effect.

9.1.7 Within fifteen (15) calendar days of the issuance of a Notice to Proceed, the Contractor shall submit one (1) signed copy of the following instruments. No payment will be processed until all of these instruments are received and approved by the Owner’s Representative.

.1 Reproducible progress and payment schedule
.2 Contractor's Schedule of Values
.3 List of material suppliers
.4 Itemized breakdown of all labor rates for each classification. Overhead and profit shall not be included. Payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor or Subcontractors. Any item or expense outside of these categories is not allowed. The expense of performing Work after regular working hours, on Saturdays, Sundays or legal holidays shall not be included in the above, unless approved in writing and in advance by Owner.

.5 Itemized breakdown of anticipated equipment rates (breakeout operator rate). Overhead and profit shall not be included. Breakdown for required equipment shall itemize (at a minimum) delivery/pick-up charge, hourly rate and hours used. Operator hours and rate shall not be included in the equipment breakdown. Contractor must use the most cost effective equipment available in the area and should not exceed the rates listed in the Rental Rate Blue Book for Construction Equipment (Blue Book). Contractor shall submit documentation for the Blue Book to support the rate being requested.

9.1.8 The Contractor shall be paid electronically using the Owner’s web-based payment program with a direct electronic transfer from the Owner’s account into the Contractor’s account. The Contractor must submit the following information to the Owner’s Representative:

.1 Bank Transit Number for the Contractor’s bank into which the electronic deposit will be made.
.2 Bank Account Number for the Contractor’s account into which the electronic deposit will be made.
.3 Contractor’s E-Mail address so that formal notification of the deposit by the Owner can be provided.

9.2 Contract Sum

9.2.1 The Owner shall compensate Contractor for all Work described herein and in the Contract Documents the Contract Sum set forth in the Contract for Construction, subject to additions and deletions as provided hereunder.

9.3 Schedule of Values

9.3.1 Within fifteen (15) days after receipt of the Notice to Proceed, the Contractor shall submit to the Owner’s Representative a schedule of values allocated to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Owner’s Representative may require. This schedule, unless objected to by the Owner’s Representative, shall be used as a basis for reviewing the Contractor's Applications for Payment. The values set forth in such schedule may, at the Owner’s option be used in any manner as fixing a basis for additions to or deletions from the Contract Sum.

9.3.2 The progress and payment schedule of values shall show the following:

.1 Enough detail as necessary to adequately evaluate the actual percent complete of any line item on a monthly basis, as determined by the Owner’s Representative.
.2 Line items, when being performed by a subcontractor or material supplier, shall correlate directly back to the subcontract or purchase order amount if requested by the Owner’s Representative.

9.4 Applications for Payment

9.4.1 The Contractor shall submit monthly to the Owner’s Representative and the Architect an itemized Application for Payment for operations completed in accordance with the Schedule of Values. Such application shall be supported by such data substantiating the Contractor's right to payment as the Owner’s Representative or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and reflecting retainage as provided for herein.

9.4.2 Such applications shall not include requests for payment of amounts the Contractor does not intend to pay to a Subcontractor or material supplier.

9.4.3 Progress payments shall be made on account of materials and equipment delivered to the site and incorporated in the Work. No payments will be made for materials and equipment stored at the Project site but not yet incorporated into the Work except as provided in Paragraph 9.4.4.

9.4.4 If approved in writing and in advance by Owner, progress payments may be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. Owner may in its sole discretion refuse to grant approval for payments for materials and equipment stored at the Project site but not yet incorporated in the Work. Any approval by Owner for payment for materials and equipment delivered and suitably
stored at the site, or stored offsite as noted below, for subsequent incorporation in the Work shall be conditioned upon Contractor’s demonstrating that such materials and equipment are adequately protected from weather, damage, vandalism and theft and that such materials and equipment have been inventoried and stored in accordance with procedures established by or approved by the Owner. Nothing in this clause shall imply or create any liability on the part of the Owner for the Contractor’s inventory and storage procedures or for any loss or damage to material, equipment or supplies stored on the site, whether incorporated into the work or not. In the event any such loss or damage occurs, the Contractor remains solely responsible for all costs associated with replacement of the affected materials, supplies and equipment including labor and incidental costs, and shall have no claim against the Owner for such loss.

No allowance shall be made in the project pay requests for materials not delivered to the site of the work and incorporated into the work, except as noted below. For the purposes of this Article, Offsite is defined as any location not owned or leased by the Owner. Contractor shall submit a list of materials that they are requesting payment for offsite storage within 60 days of Notice Proceed.

.1 Items considered to be major items of considerable magnitude, if suitably stored, may be allowed in project pay requests on the basis of ninety percent (90%) of invoices
.2 Determination of acceptable “major items of considerable magnitude” and “suitably stored” shall be made by the Owner’s Representative.
.3 Aggregate quantities of materials not considered unique to this project will not be considered for offsite storage payment.
.4 Contractor shall submit to the Owner’s Representative a list of the material for which application for payment for offsite storage is anticipated no less than forty-five days prior to the submission of the applicable pay request. The list shall include a material description, applicable division, quantity and discounts offered to the Owner for early payment. Contractor shall also submit the location the material will be stored and the method of protection.
.5 The storage facility shall be subject to approval by the Owner’s representative, shall be located within an acceptable distance of the project sites as established by the Owner’s Representative and all materials for the Owner’s project must be stored separately from all other items within the storage facility and shall be labeled and stored in the name of the Curators of the University of Missouri.
.6 The Owner’s representative shall be provided a minimum of two weeks time to visit the storage facility and inspect the stored material prior to submission of the pay request.

.7 Upon favorable inspection by the Owner’s Representative, the Contractor shall, at the Owner’s option, submit the appropriate UCC filing, transferring title of the material or equipment to The Curators of the University of Missouri.
.8 An invoice provided by the supplier shall be included with the applicable pay request.
.9 The contractor shall remain fully responsible for all items, until acceptance of the project by the Owner.
.10 The contractor shall reimburse all costs incurred by the Owner in inspecting and verifying all material stored offsite, including mileage, airfare, meals, lodging and time, charged at a reasonable hourly rate.

9.4.5 The Application for Payment shall constitute a representation by the Contractor to the Owner that the Work has progressed to the point indicated; the quality of the Work covered by the Application for Payment is in accordance with the Contract Documents; and the Contractor is entitled to payment in the amount requested.

9.4.6 The Contractor will be reimbursed for ninety-five percent (95%) of the value of all labor furnished and material installed and computed in the same manner, less all previous payments made. On projects where a bond is not required, the contractor will be reimbursed for ninety percent (90%) of the value of all labor furnished and material installed and computed in the same manner, less all previous payments made.

9.5 Approval for Payment

9.5.1 The Owner’s Representative will, within fifteen (15) days after receipt of the Contractor's Application for Payment, either approve Contractor’s Application for Payment for such amount as the Owner’s Representative determines is properly due, or notify the Contractor of the Owner’s Representative's reasons for withholding certification in whole or in part as provided in Section 9.6.

9.6 Decisions to Withhold Approval

9.6.1 The Owner’s Representative may decide not to certify payment and may withhold approval in whole or in part, to the extent reasonably necessary to protect the Owner. If the Owner’s Representative is unable to approve payment in the amount of the Application, the Owner’s Representative will notify the Contractor as provided in Paragraph 9.5.1. If the Contractor and Owner’s Representative cannot agree on a revised amount, the Owner’s Representative will promptly issue approval for payment for the amount for which the Owner’s Representative is able to determine is due Contractor. The Owner’s Representative may also decide not to approve payment or, because of subsequently discovered evidence or subsequent observations, may nullify the whole or a part of approval for payment previously issued, to such extent as may...
be necessary in the Owner’s Representative opinion to protect the Owner from loss because of:

.1 defective Work not remedied or damage to completed Work;
.2 failure to supply sufficient skilled workers or suitable materials;
.3 third party claims filed or reasonable evidence indicating probable filing of such claims;
.4 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment, Owner may, at its sole option issue joint checks to subcontractors who have presented evidence that it has not been paid in accordance with the Contract;
.5 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
.6 damage to the Owner or another contractor;
.7 reasonable evidence that the Work will not be completed within the Contract Time or an unsatisfactory rate of progress made by Contractor;
.8 Contractor's failure to comply with applicable Laws;
.9 Contractor’s or Subcontractor’s failure to comply with contract Prevailing Wage requirements; or
.10 Contractor’s failure to carry out the Work in strict accordance with the Contract Documents.

9.6.2 When the above reasons for withholding approval are removed, approval will be made for amounts previously withheld.

9.7 Progress Payments

9.7.1 Based upon Applications for Payment submitted to the Owner by the Contractor and approvals issued by the Owner’s Representative, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

9.7.2 The period covered by each Application for Payment shall be one (1) calendar month.

9.7.3 The Owner shall make payment to Contractor for amounts due and approved by Owner’s Representative not later than thirty (30) days after the Owner approves a properly detailed Application for Payment which is in compliance with the Contract Documents. The Owner shall not have the obligation to process or pay such Application for Payment until it receives an Application for Payment satisfying such requirements.

9.7.4 Based on the Schedule of Values submitted by Contractor, Applications for Payment submitted by Contractor shall indicate the actual percentage of completion of each portion of Contractor's Work as of the end of the period covered by the Application for Payment.

9.7.5 The Contractor shall promptly pay each Subcontractor and Supplier, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's or supplier's portion of the Work, the amount to which said Subcontractor or supplier is entitled, reflecting percentages actually retained from payments to the Contractor on account of each Subcontractor's or supplier's portion of the Work, in full compliance with state statute. The Contractor shall, by appropriate agreement with each Subcontractor or supplier, require each Subcontractor or supplier to make payments to Sub-subcontractors in similar manner.

9.7.6 Neither the Owner nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor of any tier nor a laborer or employee of Contractor except to the extent required by law. Retainage provided for by the Contract Documents are to be retained and held for the sole protection of Owner, and no other person, firm or corporation shall have any claim or right whatsoever thereto.

9.7.7 An approval for payment by Owner’s Representative, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

9.8 Failure of Payment

9.8.1 If the Owner is entitled to reimbursement or payment from the Contractor under or pursuant to the Contract Documents, such payment by Contractor shall be made promptly upon demand by the Owner. Notwithstanding anything contained in the Contract Documents to the contrary, if the Contractor fails to promptly make any payment due the Owner, or the Owner incurs any costs and expenses to cure any default of the Contractor or to correct defective Work, the Owner shall have an absolute right to offset such amount against the Contract Sum and may, in the Owner's sole discretion, elect either to: (1) deduct an amount equal to that to which the Owner is entitled from any payment then or thereafter due the Contractor from the Owner, or (2) issue a written notice to the Contractor reducing the Contract Sum by an amount equal to that to which the Owner is entitled.

9.9 Substantial Completion

9.9.1 Substantial Completion is the stage in the progress of the Work as defined in Paragraph 1.1.9 as certified by the Owner.

9.9.2 When the Contractor considers the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall notify the Owner and the Architect. The Owner’s Representative will make an inspection to determine whether the Work or designated
portion thereof is substantially complete. If the Owner’s Representative's inspection discloses any item which is not in accordance with the requirements of the Contract Documents, the Contractor shall complete or correct such item upon notification by the Owner’s Representative. The Contractor shall then submit a request for another inspection by the Owner’s Representative to determine Substantial Completion. When the Work or designated portion thereof is substantially complete, the Owner will issue a Certificate of Substantial Completion. Substantial Completion shall transfer from the Contractor to the Owner responsibilities for security, maintenance, heat, utilities, damage to the Work and insurance. In no event shall Contractor have more than thirty (30) days to complete all items on the Punch List and achieve Final Completion. Warranties required by the Contract Documents shall commence on the date of Substantial Completion or as agreed otherwise.

9.9.3 At the date of Substantial Completion, the Contractor may apply for, and if approved by Owner's Representative, the Owner, subject to the provisions herein, shall increase total payments to one hundred percent (100%) of the Contract Sum less one hundred fifty percent (150%) of the value of any incomplete Work and unsettled claims, as determined by the Owner’s Representative.

9.10 Partial Occupancy or Use
9.10.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retention, security, maintenance, heat, utilities, damage to the Work and insurance. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by the Owner’s Representative.

9.10.2 Immediately before such partial occupancy or use, the Owner, and Contractor shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work. Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

9.11 Final Completion and Final Payment
9.11.1 Upon receipt of written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Owner’s Representative and the Architect will promptly make such inspection and, when the Owner’s Representative and Architect find the Work acceptable under the Contract Documents and the Contract fully performed, the Owner’s Representative will promptly issue a final approval for payment; otherwise, Owner’s Representative will return Contractor’s Final Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application. Submission of a Final Application for Payment shall constitute a further representation that conditions listed in Paragraph 9.11.2 as precedent to the Contractor's being entitled to final payment have been fulfilled. All warranties and guarantees required under or pursuant to the Contract Documents shall be assembled and delivered by the Contractor to the Owner’s Representative as part of the final Application for Payment. The final approval for payment will not be issued by the Owner’s Representative until all warranties and guarantees have been received and accepted by the Owner.

9.11.2 The Owner will request the Contractor to submit the application for final payment along with a manually signed notarized letter on the Contractor's letterhead certifying that:
.1 Labor costs, prevailing wage rates, fringe benefits and material costs have been paid.
.2 Subcontractors of any tier and manufacturers furnishing materials and labor for the project have fully completed their Work and have been paid in full.
.3 The project has been fully completed in accordance with the Contract Documents as modified by Change Orders.
.4 The acceptance by Contractor of its Final Payment, by check or electronic transfer, shall be and operate as a release of all claims of Contractor against Owner for all things done or furnished or relating to the Work and for every act or alleged neglect of Owner arising out of the Work.

9.11.3 Final Payment constituting the entire unpaid balance due shall be paid by the Owner to the Contractor within thirty (30) days after Owner's receipt of Contractor's Final Application for Payment which satisfies all the requirements of the Contract Documents and Owner’s receipt of all information and documents set forth in Section 9.11.

9.11.4 No payment under this Contract, including but not limited to final payment, shall constitute acceptance by Owner of any Work or act not in accordance with the requirements of the Contract Documents.

9.11.5 No recourse shall be had against any member of the Board of Curators, or officer thereof, for any payment under the Contract or any claim based thereon.

ARTICLE 10
PROTECTION OF PERSONS AND PROPERTY
10.1 **Safety Precautions and Programs**

**10.1.1** The Contractor shall at all times conduct operations under this Contract in a manner to avoid the risk of bodily harm to persons or risk of damage to any property. The Contractor shall promptly take precautions which are necessary and adequate against conditions created during the progress of the Contractor's activities hereunder which involve a risk of bodily harm to persons or a risk of damage to property. The Contractor shall continuously inspect Work, materials, and equipment to discover and determine any such conditions and shall be solely responsible for discovery, determination, and correction of any such conditions. The Contractor shall comply with applicable safety laws, standards, codes, and regulations in the jurisdiction where the Work is being performed, specifically, but without limiting the generality of the foregoing, with rules regulations, and standards adopted pursuant to the Williams-Steiger Occupational Safety and Health Act of 1970 and applicable amendments.

**10.1.2** All contractors, subcontractors and workers on this project are subject to the Construction Safety Training provisions 292.675 RSMo.

**10.1.3** In the event the Contractor encounters on the site, material reasonably believed to be asbestos, polychlorinated biphenyl (PCB), lead, mercury, or other material known to be hazardous, which has not been rendered harmless, the Contractor shall immediately stop Work in the area affected and report the condition to the Owner's Representative and the Architect in writing. The Work in the affected area shall not thereafter be resumed except by written agreement of the Owner's Representative and Contractor if in fact the material is asbestos or polychlorinated biphenyl (PCB) and has not been rendered harmless. The Work in the affected area shall be resumed in the absence of asbestos or polychlorinated biphenyl (PCB), or when it has been rendered harmless by written agreement of the Owner's Representative and the Contractor. “Rendered Harmless” shall mean that levels of such materials are less than any applicable exposure standards, including but limited to OSHA regulations.

**10.2 Safety Of Persons And Property**

**10.2.1** The Contractor shall take reasonable precautions for safety of, and shall provide protection to prevent damage, injury, or loss to:

1. students, faculty, staff, the public, construction personnel, and other persons who may be affected thereby;

2. the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor or the Contractor's Subcontractors of any tier; and

.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

**10.2.2** The Contractor shall give notices and comply with applicable laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury, or loss.

**10.2.3** The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, safeguards for safety and protection, including, but not limited to, posting danger signs and other warnings against hazards, promulgating safety regulations, and notifying owners and users of adjacent sites and utilities.

**10.2.4** When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise the highest degree of care and carry on such activities under supervision of properly qualified personnel.

**10.2.5** The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Article 10 caused in whole or in part by the Contractor, a Subcontractor of any tier, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable, and for which the Contractor is responsible under Article 10, except damage or loss attributable solely to acts or omissions of Owner or the Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's other obligations stated elsewhere in the Contract.

**10.2.6** The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents, and the maintaining, enforcing and supervising of safety precautions and programs. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner's Representative and Architect. The Contractor shall hold regularly scheduled safety meetings to instruct Contractor personnel on safety practices, accident avoidance and prevention, and the Project Safety Program. The Contractor shall furnish safety equipment, and enforce the use of such equipment by it's employees and it's subcontractors of any tier.

**10.2.7** The Contractor shall not load or permit any part of the construction or site to be loaded so as to endanger its safety.
10.2.8 The Contractor shall promptly report in writing to the Owner all accidents arising out of or in connection with the Work which cause death, lost time injury, personal injury, or property damage, giving full details and statements of any witnesses. In addition, if death, serious personal injuries, or serious property damages are caused, the accident shall be reported immediately by telephone or messenger to the Owner.

10.2.9 The Contractor shall promptly notify in writing to the Owner of any claims for injury or damage to personal property related to the work, either by or against the Contractor.

ARTICLE 11
INSURANCE & BONDS

11.1 Insurance
11.1.1 Contractor shall secure from the date of the Contract for Construction and maintain for such periods of time as set forth below, insurance of such types and in such amounts specified below, to protect Contractor, Owner and others against all hazards or risks of loss described below. The form of such insurance together with carriers thereof, in each case, shall be approved by Owner, but, regardless of such approval, it shall be the responsibility of Contractor to maintain the insurance coverages set forth herein.

11.1.2 The contractor shall not be allowed on the Owners property without proof of the insurance coverages set forth herein.

11.2 Commercial General Liability
11.2.1 Contractor shall secure and maintain from the date of the Contract and for a period of at least five (5) years from the date of Final Completion of the entire Work Commercial General Liability insurance (“CGL”) with a combined single limit of not less than $2,000,000 per occurrence, $5,000,000 general aggregate, $5,000,000 products and completed operations aggregate and $1,000,000 personal injury and advertising injury. General Aggregate should apply per project. An umbrella policy may be used to satisfy these limits. If the General Aggregate is not on a per project basis, the contractor shall provide an additional $2,000,000 general aggregate.

11.2.2 CGL insurance shall be written on a comprehensive form and shall cover claims and liability in connection with or resulting from the Contractor’s operations and activities under the Contract, for personal injuries, occupational sickness, disease, death or damage to property of others, including loss of use resulting therefrom, arising out of any operations or activities of the Contractor, its agents, or any Subcontractors of any tier or by anyone directly or indirectly employed by either of them.

11.2.3 CGL insurance shall include premises, operations, independent contractors, products-completed operations, personal injury and advertising injury and liability assumed under an insured contract (including the tort liability of another assumed in a business contract) coverages. In particular, and not by way of any limitation, the CGL insurance shall cover the Contractor’s indemnity obligations contained in the Contract Documents.

11.2.4 There shall be no endorsement or modification of the CGL policy limiting the scope of coverage for liability arising from blasting, explosion, collapse, or underground property damage.

11.2.5 “The Curators of the University of Missouri” shall be endorsed as an “additional insured” under the CGL policy. The additional insured status must be conveyed by using the ISO CG 2 10 (2004) edition or equivalent and the ISO CG 20 37 (2004) edition. The policy shall be endorsed to be primary coverage and any other insurance carried by the Owner shall be excess only and will not contribute with Contractors’ insurance. To confirm, the Endorsement should accompany the insurance certificate.

11.2.6 Contractor waives all rights against Owner and its agents, officers, representatives and employees for recovery of damages to the extent those damages are covered by the CGL policy required hereunder.

11.3 Licensed for Use Vehicle Liability
11.3.1 Contractor shall secure and maintain from the date of the Contract for Construction until the date of Final Completion of the entire Work, insurance, to be on comprehensive form, which shall protect Contractor against any and all claims for all injuries and all damage to property arising from the use of automobiles, trucks and motorized vehicles, in connection with the performance of Work under this Contract, and shall cover the operation on or off the site of the Work of all motor vehicles licensed for highway use whether they are owned, non-owned or hired. Such insurance shall include contractual liability coverage and shall provide coverage on the basis of the date of any accident. The liability limits under such policy shall not be less than $2,000,000 combined single limit for bodily injury and property damage per accident.

11.3.2 Contractor waives all rights against Owner and its agents, officers, directors and employees for recovery of damages to the extent such damages are covered by the automobile liability insurance required hereunder.

11.4 Workers’ Compensation Insurance
11.4.1 Contractor shall purchase and maintain workers’ compensation insurance and employers’ liability insurance...
which shall protect Contractor from claims for injury, sickness, disease or death of Contractor’s employees or statutory employees. The insurance policies required hereunder shall include an “all states” or “other states” endorsement. In case any Work is sublet, Contractor shall require any Subcontractor of any tier to provide the insurance coverages required under this Section 11.4.

11.4.2 Contractor’s workers’ compensation insurance coverage shall be in compliance with all applicable Laws, including the statutes of the State of Missouri. Contractor’s employers’ liability coverage limits shall not be less than $1,000,000 each accident for bodily injury by accident or $1,000,000 each employee for bodily injury by disease.

11.5 Liability Insurance General Requirements

11.5.1 All insurance coverages procured by Contractor shall be provided by agencies and insurance companies acceptable to and approved by Owner. Any insurance coverage shall be provided by insurance companies that are duly licensed to conduct business in the State of Missouri as an admitted carrier. The form and content of all insurance coverage provided by Contractor are subject to the approval of Owner. All required insurance coverages shall be obtained and paid for by Contractor. Any approval of the form, content or insurance company by Owner shall not relieve the Contractor from the obligation to provide the coverages required herein.

11.5.2 All insurance coverages procured by the Contractor shall be provided by insurance companies having policyholder ratings no lower than “A-” and financial ratings not lower than “XI” in the Best’s Insurance Guide, latest edition in effect as of the date of the Contract, and subsequently in effect at the time of renewal of any policies required by the Contract Documents. Insurance coverages required hereunder shall not be subject to a deductible amount on a per-claim basis of more than $10,000.00 and shall not be subject to a per-occurrence deductible of more than $25,000.00. Insurance procured by Contractor covering the additional insureds shall be primary insurance and any insurance maintained by Owner shall be excess insurance.

11.5.3 All insurance required hereunder shall provide that the insurer’s cost of providing the insureds a defense and appeal, including attorneys’ fees, shall be supplementary and shall not be included as part of the policy limits but shall remain the insurer’s separate responsibility. Contractor shall cause its insurance carriers to waive all rights of subrogation, except for Workers’ Compensation, against the Owner and its officers, employees and agents.

11.5.4 The Contractor shall furnish the Owner with certificates, Additional Insured endorsements, policies, or binders which indicate the Contractor and/or the Owner and other Contractors (where required) are covered by the required insurance showing type, amount, class of operations covered, effective dates and dates of expiration of policies prior to commencement of the work. Contractor is required to maintain coverages as stated and required to notify the University of a Carrier Change or cancellation within 2 business days. The University reserves the right to request a copy of the policy. Contractor fails to provide, procure and deliver acceptable policies of insurance or satisfactory certificates or other evidence thereof, the Owner may obtain such insurance at the cost and expense of the Contractor without notice to the Contractor.

11.5.5 With respect to all insurance coverages required to remain in force and affect after final payment, Contractor shall provide Owner additional certificates, policies and binders evidencing continuation of such insurance coverages along with Contractor’s application for final payment and shall provide certificates, policies and binders thereafter as requested by Owner.

11.5.6 The maintenance in full current force and effect of such forms and amounts of insurance and bonds required by the Contract Documents shall be a condition precedent to Contractor’s exercise or enforcement of any rights under the Contract Documents.

11.5.7 Failure of Owner to demand certificates, policies and binders evidencing insurance coverages required by the Contract Documents, approval by Owner of such certificates, policies and binders or failure of Owner to identify a deficiency from evidence that is provided by Contractor shall not be construed as a waiver of Contractor’s obligations to maintain the insurance required by the Contract Documents.

11.5.8 The Owner shall have the right to terminate the Contract if Contractor fails to maintain the insurance required by the Contract Documents.

11.5.9 If Contractor fails to maintain the insurance required by the Contract Document, Owner shall have the right, but not the obligation, to purchase said insurance at Contractor’s expense. If Owner is damaged by Contractor’s failure to maintain the insurance required by the Contract Documents, Contractor shall bear all reasonable costs properly attributable to such failure.

11.5.10 By requiring the insurance set forth herein and in the Contract Documents, Owner does not represent or warrant that coverage and limits will necessarily be adequate to protect Contractor, and such coverages and limits shall not be deemed as a limitation on Contractor’s liability under the indemnities granted to Owner in the Contract Documents.
11.5.11 If Contractor’s liability policies do not contain a standard separation of insureds provision, such policies shall be endorsed to provide cross-liability coverage.

11.5.12 If a part of the Work hereunder is to be subcontracted, the Contractor shall: (1) cover any and all Subcontractors in its insurance policies; (2) require each Subcontractor to secure insurance which will protect said Subcontractor and supplier against all applicable hazards or risks of loss designated in accordance with Article 11 hereunder; and (3) require each Subcontractor or supplier to assist in every manner possible in the reporting and investigation of any accident, and upon request, to cooperate with any insurance carrier in the handling of any claim by securing and giving evidence and obtaining the attendance of witnesses as required by any claim or suit.

11.5.13 It is understood and agreed that the insurance coverages required by the provisions of this Article 11 are required in the public interest and that the Owner does not assume any liability for acts of Contractor or Subcontractors of any tier or their employees in the performance of the Contract or Work.

11.6 Builder’s Risk Insurance
11.6.1 The Contractor shall purchase and maintain, in a company or companies lawfully authorized to do business in the State of Missouri, as an admitted carrier, builder’s risk insurance on the entire Work. Such insurance shall be written on a completed value form for the entire Work. The insurance shall apply on a replacement cost basis.

11.6.2 The insurance as required herein shall name as insureds the Owner, Contractor and all Subcontractors of any tier. The insurance policy shall contain a provision that the insurance will not be canceled, allowed to expire or materially changed until at least thirty (30) days prior written notice has been given to Owner.

11.6.3 The insurance as required herein shall cover the entire Work, including reasonable compensation for Architect’s services and expenses made necessary by an insured loss. Insured property shall include portions of the Work located away from the site (including all offsite stored materials) but intended for use at the site, and shall also cover portions of the Work in transit, including ocean transit. The policy shall include as insured property scaffolding, falsework, and temporary buildings located at the site. The policy shall cover the cost of removing debris, including demolition as may be made legally necessary by the operation of any law, ordinance or regulation.

11.6.4 The insurance required herein shall be on an all risk form and shall be written to cover all risks of physical loss or damage to the insured party and shall insure at least against the perils of fire and extended coverage, theft, vandalism, malicious mischief, collapse, lightning, earthquake, flood, frost, water damage, windstorm and freezing.

11.6.5 If there are any deductibles applicable to the insurance required herein, Contractor shall pay any part of any loss not covered because of the operation of such deductibles.

11.6.6 The insurance as required herein shall be maintained in effect until the earliest of the following dates:
.1 the date which all persons and organization who are insureds under the policy agree in writing that it shall be terminated;
.2 the date on which final payment of this Contract has been made by Owner to Contractor; or
.3 the date on which the insurable interests in the property of all insureds other than the Owner have ceased.

11.6.7 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors of any tier, suppliers, agents and employees, each of the other, (2) the Architect and Architect's consultants, and (3) separate contractors described in Article 6, if any, and any of their subcontractors of any tier, suppliers, agents and employees, for damages caused by fire or other perils to the extent covered by property insurance obtained pursuant to this Section 11.7 or other insurance applicable to the Work, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6, if any, and the subcontractors of any tier, suppliers, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, was at fault or was negligent in causing the loss and whether or not the person or entity had an interest in the property damaged.

11.6.8 A loss insured under Contractor's property insurance shall be adjusted by the Owner in good faith and made payable to the Owner for the insureds, subject to requirements of the Contract Documents. The Contractor shall pay Subcontractors of any tier their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors of any tier to make payments to their Sub-subcontractors in similar manner.

11.7 Bonds

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08/18
11.7.1 When the Contract sum exceeds Fifty Thousand Dollars ($50,000), the Contractor shall procure and furnish a Performance Bond and a Payment Bond in the form prepared by the Owner, each in an amount equal to one hundred percent (100%) of the Contract Sum, as well as adjustments to the Contract Sum. The Performance Bond shall secure and guarantee Contractor’s faithful performance of this Contract, including but not limited to Contractor’s obligation to correct defects after final payment has been made as required by the Contract Documents. The Payment Bond shall secure and guarantee payment of all persons performing labor on the Project under this Contract and furnishing materials in connection with this Contract. These Bonds shall be in effect through the duration of the Contract plus the Guaranty Period as required by the Contract Documents.

11.7.2 The bonds required hereunder shall be executed by a responsible surety licensed in the State of Missouri, with a Best’s rating of no less than A-/XI. The Contractor shall require the attorney in fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of this power of attorney indicating the monetary limit of such power.

11.7.3 If the surety of any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to conduct business in the State of Missouri is terminated, or it ceases to meet the requirements of this paragraph, Contractor shall within ten (10) days substitute another bond and surety, both of which must be acceptable to Owner. If Contractor fails to make such substitution, Owner may procure such required bonds on behalf of Contractor at Contractor's expense.

11.7.4 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds to such person or entity.

11.7.5 The Contractor shall keep the surety informed of the progress of the Work, and, where necessary, obtain the surety's consent to or waiver of: (1) notice of changes in the Work; (2) request for reduction or release of retention; (3) request for final payment; and (4) any other material required by the surety. The Owner shall be notified by the Contractor, in writing, of all communications with the surety, as it relates to items one through four. The Owner may, in the Owner's sole discretion, inform surety of the progress of the Work, any defects in the Work, or any defaults of Contractor under the Contract Documents and obtain consents as necessary to protect the Owner's rights, interest, privileges and benefits under and pursuant to any bond issued in connection with the Work.

11.7.6 Contractor shall indemnify and hold harmless the Owner and any agents, employees, representative or member of the Board of Curators from and against any claims, expenses, losses, costs, including reasonable attorneys’ fees, as a result of any failure of Contractor to procure the bonds required herein.

ARTICLE 12
UNCOVERING AND CORRECTION OF THE WORK

12.1 Uncovering of the Work
12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it shall, if required in writing by the Architect or the Owner's Representative, be uncovered for the Architect's observation and be replaced at the Contractor's expense without change in the Contract Time.

12.1.2 If a portion of the Work has been covered which the Architect or the Owner's Representative has not specifically requested to observe, and if it ceases to meet the requirements of the Contract Documents, it shall, if required in writing by the Architect or the Owner's Representative, be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be charged to the Owner. If such Work is not in accordance with the Contract Documents, the Contractor shall pay such costs unless the condition was caused by the Owner or a separate contractor in which event the Owner will be responsible for payment of such costs.

12.2 Correction of the Work
12.2.1 The Architect or Owner's Representative shall have the right to reject Work not in strict compliance with the requirements of the Contract Documents. The Contractor shall promptly correct Work rejected by the Architect or the Owner’s Representative for failing to conform to the requirements of the Contract Documents, whether observed before or after final completion and whether or not fabricated, installed, or completed. If Work has been rejected by Architect or Owner’s Representative, the Architect or Owner's Representative shall have the right to require the Contractor to remove it from the Project site and replace it with Work that strictly conforms to the requirements of the Contract Documents regardless if such removal and replacement results in “economic waste.” Contractor shall pay all claims, costs, losses and damages caused by or resulting from the correction, removal or replacement of defective Work, including but not limited to, all costs of repair or replacement of Work of others. The Contractor shall bear costs of correcting, removing and replacing such rejected Work, including additional testing and inspections and compensation for the Architect's services and expenses made necessary thereby. If prior to the date of final payment, the Contractor, a Subcontractor or anyone for whom either is responsible uses or damages any portion of
the Work, including, without limitation, mechanical, electrical, plumbing and other building systems, machinery, equipment or other mechanical device, the Contractor shall cause such item to be restored to “like new” condition at no expense to the Owner.

**12.2.2** If, within twelve (12) months after the date of Final Completion of the Work or designated portion thereof, or after the date for commencement of warranties, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found not to be in strict accordance with the requirements of the Contract Documents, the Contractor shall correct or remove and replace such defective Work, at the Owner’s discretion. Such twelve (12) month period is referred to as the “Guarantee Period.” The obligations under this Paragraph 12.2.2 shall cover any repairs, removal and replacement to any part of the Work or other property caused by the defective Work.

**12.2.3** The Contractor shall remove from the site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

**12.2.4** If the Contractor fails to correct nonconforming Work within a reasonable time, the Owner may correct or remove it and replace such nonconforming Work. If the Contractor does not proceed with correction of such nonconforming Work within a reasonable time fixed by written notice from the Owner, the Owner may take action to correct or remove the nonconforming work at the contractor’s expense.

**12.2.5** The Contractor shall bear the cost of correcting destroyed or damaged Work or property, whether completed or partially completed, of the Owner or of others caused by the Contractor's correction or removal of Work which is not in accordance with the requirements of the Contract Documents.

**12.2.6** Nothing contained in Article 12 shall be construed to establish a period of limitation with respect to other obligations that the Contractor might have under the Contract Documents. Establishment of the twelve (12) month Guarantee Period as described in Article 12 relates only to the specific obligation of the Contractor to correct, remove or replace the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations under the Contract Documents. The requirements of Article 12 are in addition to and not in limitation of any of the other requirements of the Contract for warranties or conformance of the Work to the requirements of the Contract Documents.

**12.3** Acceptance of Nonconforming Work

**12.3.1** The Owner may accept Work which is not in accordance with the Contract Documents, instead of requiring its removal and correction, in its sole discretion. In such case the Contract Sum will be adjusted as appropriate and equitable. Such adjustment shall be made whether or not final payment has been made. Nothing contained herein shall impose any obligation upon the Owner to accept nonconforming or defective Work.

**ARTICLE 13**

**MISCELLANEOUS PROVISIONS**

**13.1** Written Notice

**13.1.1** All notices required to be given by the contractor under the terms of this Contract shall be made in writing. Written notice when served by the Owner will be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an office of the corporation for which it was intended, or if delivered at or sent to the last business address known to the party giving notice.

**13.2** Rights and Remedies

**13.2.1** Duties and obligations imposed by the Contract Documents, and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

**13.2.2** No action or failure to act by the Owner, the Architect, or the Owner’s Representative will constitute a waiver of a right or duty afforded to the Owner under the Contract Documents, nor will such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed in writing.

**13.2.3** The terms of this Contract and all representations, indemnifications, warranties and guarantees made in, required by or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion and acceptance of the Work and termination or completion of the Work and shall remain in effect so long as the Owner is entitled to protection of its rights under applicable law.

**13.2.4** Contractor shall carry out the Work and adhere to the current construction schedule during all disputes or disagreements with the Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements except as the Owner and Contractor may otherwise agree to in writing.
13.3 Tests and Inspections

13.3.1 Tests, inspections, and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules or regulations shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, and shall bear related costs of tests, inspections, and approvals. The Contractor shall give the Architect and the Owner's Representative timely notice of when and where tests and inspections are to be made so the Architect and/or the Owner's Representative may observe procedures.

13.3.2 If the Architect or the Owner's Representative determine that portions of the Work require additional testing, inspection or approval not included in the Contract Documents, or required by law, the Architect, or the Owner's Representative will instruct the Contractor to make arrangements for such additional testing, inspection, or approval by an entity acceptable to the Owner's Representative and the Contractor shall give timely notice to the Architect, and the Owner's Representative, of when and where tests and inspections are to be made so the Architect and/or the Owner's Representative may observe such procedures. The Owner will bear such costs except as provided elsewhere in Article 13.

13.3.3 If such procedures for testing, inspection, or approval under Article 13 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, the Contractor shall bear all costs made necessary by such failure including those of repeated procedures and compensation for the Architect's services and expenses.

13.3.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Owner's Representative and Architect.

13.3.5 Contractor shall take all necessary actions to ensure that all tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

13.3.6 Contractor shall arrange for and pay for all costs of all testing required by the Contract Documents or any applicable Laws for materials to be tested or certified at or on the place or premises of the source of the material to be supplied. The Owner shall have the right to require testing of all materials at the place of the source of the material to be supplied if not required by the Contract Documents or any applicable Laws. The Owner shall bear the costs of such tests and inspections not required by the Contract Documents or by applicable Laws unless prior defective Work provides Architect or Owner with a reasonable belief that additional defective Work may be found, in which case Contractor shall be responsible for all costs of tests and inspections ordered by the Owner or Architect, whether or not such tests or inspections reveals that Work is in compliance with the Contract Documents.

13.4 Nondiscrimination in Employment Equal Opportunity

13.4.1 The University serves from time to time as a contractor for the United States government. Accordingly, the provider of goods and/or services shall comply with federal laws, rules and regulations applicable to subcontractors of government contracts including those relating to equal employment opportunity and affirmative action in the employment of minorities (Executive Order 11246), women (Executive Order 11375), persons with disabilities (29 USC 706) and Executive Order 11758, and certain veterans (38 USC 4212 (formerly [2012]) contracting with business concerns with small disadvantaged business concerns (Publication L. 95-507). Contract clauses required by the Government in such circumstances are incorporated herein by reference.

13.5 Supplier Diversity Goal Program

13.5.1 The Contractor shall subcontract with diverse firms no less than the amount pledged in the Contractor’s Bid and/or the amount accepted by the Owner.

13.5.2 If the Contractor must remove any diverse subcontractor of any tier, the Contractor shall replace the diverse subcontractor of any tier with another diverse subcontractor(s) of equal dollar value to the diverse supplier removed. The Contractor shall immediately notify the Owner's Representative in writing of the Contractor’s intent to remove any, and the Contractor’s plan to maintain subcontracts with diverse firms of no less than amount pledged in the Contractor’s Bid and/or the amount accepted by the Owner. All changes of diverse subcontractor of any tier shall be approved by the Director of Facilities Planning & Development.

13.5.3 If the Contractor fails to meet or maintain the contractor’s Supplier Diversity subcontracting pledge, the Contractor shall immediately notify in writing the Owner’s Representative, and the Director of Facilities Planning & Development. Such notice shall include a description of the Contractor’s good faith effort to comply with their Supplier Diversity subcontracting pledge.

13.5.4 If the Director of Facilities Planning & Development finds the Contractor has failed to comply in good faith with the Owner’s Supplier Diversity goal program, the Director may take appropriate action, including but not limited to, declaring the Contractor ineligible to participate in any contracts with the Owner for a period not to exceed six (6) months, and/or directing that the Contractor's actions be
declared a material breach of the Contract and that the Contract be terminated.

13.5.5 The Contractor and his subcontractors shall develop, implement, maintain, and submit in writing to the Director of Facilities Planning & Development, an affirmative action program if at least fifty (50) persons in the aggregate are employed under this contract. If less than fifty (50) persons in the aggregate are to be employed under this contract, the Contractor shall submit, in lieu of the written affirmative action program, a properly executed "Affidavit for Affirmative Action" in the form as included in the Contract Documents. For the purpose of this section, an "Affirmative Action Program" means positive actions to influence all employment practices (including, but not limited to, recruiting, hiring, promoting, and training) in providing equal employment opportunity regardless of race, color, sex, national origin, religion, age (where the person affected is between 40 and 70), disabled and Vietnam-era veteran status, and handicapped otherwise qualified status. Such affirmative action program shall include:

.1 A written policy statement committing the total organization to affirmative action and assigning management responsibilities and procedures for evaluation and dissemination.

.2 The identification of a person designated to handle affirmative action.

.3 The establishment of non-discriminatory selection standards, objective measures to analyze recruitment, an upward mobility system, a wage and salary structure, and standards applicable to lay-off, recall, discharge, demotion, and discipline.

.4 The exclusion of discrimination from collective bargaining agreements.

.5 Performance of an internal audit of the reporting system to monitor execution and to provide for future planning.

13.5.6 In the enforcement of this non-discrimination requirement, the Owner may use any reasonable procedures available, including but not limited to: requests, reports, site visits, and inspection of relevant documents of Contractors and Subcontractors of any tier. The contractor shall submit a final Affidavit of Supplier Diversity Participation for each diverse firm at the end of the project stating the actual amount paid to the diverse firm.

13.6 Wage Rates (If the contract amount is less than $75,000, the requirements of this section will not apply. Any contract adjustments that increase the contract above $75,000 will be subject to this section.)

13.6.1 The Contractor shall pay workers employed in the execution of this contract in full each week and not less than the predetermined wage rates and overtime for work of a similar character that have been made a part of this Contract. These rates are determined by the University of Missouri Director of Facilities Planning and Development. The rates are based on wage rates published in the Annual Wage Orders of the Missouri Department of Labor and Industrial Relations (MDLIR). The Contractor is to use MDLIR 8 CSR 30-3.020; .030; .040, .060 in determining the appropriate occupational titles and rates for workers used in the execution of this contract. All determinations and/or interpretations regarding wage rates and classification of workers will be made by the office of the University of Missouri Director of Facilities Planning and Development. The Contractor is responsible for the payment of the aggregate of the Basic Hourly Rate and the Total Fringe Benefits to the workers on the project. Fringe benefit payments may be made to the worker in cash, or irrevocably made by a Contractor or Subcontractor to a trustee or to a third person pursuant to a fund, plan or program, or pursuant to an enforceable commitment, or any combination thereof, to carry out a financially responsible plan or program which was communicated in writing to the workmen affected, for medical or hospital care, pensions on retirement or death, compensation for injuries or illness resulting from occupational activity, or insurance to provide any of the foregoing, for unemployment benefits, life insurance, disability and sickness insurance, accident insurance, for vacation and holiday pay, for defraying costs of apprenticeship or other similar programs, or for other bona fide fringe benefits, but only where the Contractor or Subcontractor is not required by other federal or state law to provide any of the benefits as referenced in §290.210(5) RSMo 1994. Pay for travel, mileage, meals, bonuses, or other expenses are not fringe benefits and cannot be considered part of the workers wage rate. The Contractor shall not make any deductions for food, sleeping accommodations, transportation, use of small tools, uniforms, or anything of any kind or description, unless the Contractor and employee enter into an agreement in writing at the beginning of the worker’s term of employment, and such agreement is approved by the Owner. In the event the contract contains more than one wage determination the Contractor shall comply with both.

13.6.2 The Contractor shall submit to the Owner with the Contractor’s periodic pay request, certified payroll records for labor performed by the Contractor and Subcontractors of any tier. The Contractor shall submit all required certified payroll information records electronically in pdf format using the Owner’s web-based payment program. The certified payroll forms shall contain the name, address, personal identification number, and occupational title of the workers as well as the hours they work each day. The Owner’s acceptance of certified payroll records does not in any way relieve the Contractor of any responsibility for the payment of prevailing wages to workers on the project. The Contractor shall also maintain copies of the certified payroll.
The provisions of Article 13.6 would be difficult to enforce. The cost of Contractor's violation of the delays, of additional work for Owner's staff and legal requirements of Article 13.6 result in additional costs to Contractor. The liquidated damages and other provisions of this Article 13.6. Such liquidated damages shall be entitled to retain or recover from the Contractor, as liquidated damages and not as a penalty, the sum of Fifty Dollars ($50.00) per day per individual who is paid less than the applicable prevailing wage, to approximate the investigative cost resulting to the Owner for such violations. To approximate the delay costs, Owner shall be entitled to retain or recover from the Contractor, as liquidated damages and not as a penalty, the sum of One Hundred Dollars ($100.00) per day for each day the Contract cannot be closed out and final payment made because of Contractor's failure to comply with the provisions of this Article 13.6. Such liquidated damages shall be collected regardless of whether the Work has been completed. The liquidated damages and other amounts set forth in this Article 13.6 shall be in addition to all other liquidated damages the Owner may be entitled as set forth in the Contract Documents.

13.6.6 The Owner may deduct liquidated damages described Article 13 and the amounts set forth in Article 13 from any unpaid amounts then or thereafter due the Contractor under the Contract. Any liquidated damages not so deducted from any unpaid amounts due the Contractor shall be payable to the Owner at the demand of the Owner.

13.6.7 The Contractor shall specifically incorporate the obligations of Article 13 into the subcontracts, supply agreements and purchase orders for the Work and require the same of any Subcontractors of any tier.

13.6.8 Contractor acknowledges and recognizes that a material factor in its selection by the Owner is the Contractor's willingness to undertake and comply with the requirements of this Article 13.6. If Contractor fails to comply with the provisions of this Article 13.6, Owner may, in its sole discretion, immediately terminate the Contract upon written notice. The rights and remedies of Owner provided herein shall not be exclusive and are in addition to other rights and remedies provided by law or under this Contract.

13.6.9 Only such workers who are individually registered in a bona fide apprenticeship program approved by the U.S. Department of Labor, Office of Apprenticeship can be paid less than the journeyperson rate of pay. “Entry Level Workers; must be registered apprentices. The apprenticeship ratio will be one to one with a journeyperson of the same classification. Any worker not registered as an apprentice per this section will be paid as a journeyperson.

13.6.10 The Contractor shall post the wage rates for the contract in a conspicuous place at the field office on the project. On projects where there is no field office the Contractor may post the wage rates at their local office, as long as they provide a copy of the wage rates to a worker upon request. The wage rates shall be kept in a clearly legible condition for the duration of the project.

13.6.11 Neither the Contractor, nor any Subcontractor of any tier, nor any person hired by them or acting on their behalf, shall request or demand that workers pay back, return, donate, contribute or give any part, or all, of said workers wages, salary, or any thing of value, upon the statement, representation or understanding that failure to comply with such request or demand will prevent such worker from procuring or retaining employment. The exception being to an agent or representative of a duly constituted labor organization acting in the collection of dues or assessments of such organization.
13.6.12 No contractor or subcontractor may directly or indirectly receive a wage subsidy, bid supplement, or rebate for employment on this project if such wage subsidy, bid supplement, or rebate has the effect of reducing the wage rate paid by the employer on a given occupational title below the prevailing wage rate as provided in contract. In the event a wage subsidy, bid supplement, or rebate is provided or received, the entity receiving such subsidy, supplement, or rebate shall report the date and amount of such subsidy, supplement, or rebate to the University within thirty days of receipt of payment. This disclosure report shall be a matter of public record. Any employer not in compliance with this Article shall owe to the University double the dollar amount per hour that the wage subsidy, bid supplement, or rebate has reduced the wage rate paid by the employer below the prevailing wage rate for each hour that work was performed.

13.6.13 Time and one half overtime will be paid on all hours over 10 hours per day or 40 hours per week. The wage rate is the total of the “Basic Hourly Rate” plus “Total Fringe Benefits” or the “public works contracting minimum wage”. For all work performed on a Sunday or Holiday, not less than twice the prevailing hourly rate of pay or public works contracting minimum wage will apply. Holidays are as follows: January first, the last Monday in May, July fourth, the first Monday in September, November 11, the fourth Thursday in November, December twenty-fifth. If any holiday falls on a Sunday, the following Monday shall be considered a holiday.

13.7 Records

13.7.1 The Owner, or any parties it deems necessary, shall have access to and the right to examine any accounting or other records of the Contractor involving transactions and Work related to this Contract for five (5) years after final payment or five (5) years after the final resolution of any on going disputes at the time of final payment. All records shall be maintained in accordance with generally accepted accounting procedures, consistently applied. Subcontractors of any tier shall be required by Contractor to maintain records and to permit audits as required of Contractor herein.

13.8 Codes and Standards

13.8.1 The Work shall be performed to comply with the International Code Council (ICC) Codes, and the codes and standards noted below. The latest editions and supplements of these Codes and Standards in effect on the date of the execution of the Contract for Construction shall be applicable unless otherwise designated in the Contract Documents. Codes and standards required by accreditation agencies will also be used unless the ICC requirements are more stringent. In the event that special design features and/or construction systems are not covered in the ICC codes, the applicable edition of the National Fire Protection Association (NFPA) family of standards and/or the NFPA 101 Life Safety Code shall be used.

1. ICC International Building Code and reference standards
2. ICC International Plumbing Code
3. ICC International Mechanical Code
4. NFPA 70 National Electric Code (NEC)
7. NFPA 101 Life Safety Code (as noted above)
8. American Concrete Institute (ACI)
9. American National Standards Institute (ANSI)
10. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
11. American Refrigeration Institute (ARI)
14. National Electrical Manufacturers Association (NEMA)
15. Underwriter's Laboratories, Inc. (UL), Federal Specifications
16. Williams Steiger Occupational Safety and Health Act of 1970 (OSHA)

13.9 General Provisions

13.9.1 Any specific requirement in this Contract that the responsibilities or obligations of the Contractor also apply to a Subcontractor is added for emphasis and are also hereby deemed to include a Subcontractor of any tier. The omission of a reference to a Subcontractor in connection with any of the Contractor's responsibilities or obligations shall not be construed to diminish, abrogate or limit any responsibilities or obligations of a Subcontractor of any tier under the Contract Documents or the applicable subcontract.

13.9.2 This Contract shall be interpreted, construed, enforced and regulated under and by the laws of the State of Missouri. Whenever possible, each provision of this Contract shall be interpreted in a manner as to be effective and valid under applicable law. If, however, any provision of this Contract, or a portion thereof, is prohibited by law or found invalid under any law, only such provision or portion thereof shall be ineffective, without invalidating or affecting the remaining provisions of this Contract or valid portions of such provision, which are hereby deemed severable. Contractor and Owner further agree that in the event any provision of this Contract, or a portion thereof, is prohibited by law or found
13.9.3 Contractor and Owner each agree that the State of Missouri Circuit Court for the County where the Project is located shall have exclusive jurisdiction to resolve all claims and any issue and disputes between Contractor and Owner. Contractor agrees that it shall not file any petition, complaint, lawsuit or legal proceeding against Owner in any other court other than the State of Missouri Circuit Court for the County where the Project is located.

13.9.4 Owner’s total liability to Contractor and anyone claiming by, through, or under Contractor for any claim, cost, loss, expense or damage caused in part by the fault of Owner and in part by the fault of Contractor or any other entity or individual shall not exceed the percentage share that Owner’s fault bears to the total fault of Owner, Contractor and all other entities and individuals as determined on the basis of comparative fault principles.

13.9.5 Contractor agrees that Owner shall not be liable to Contractor for any special, indirect, incidental, or consequential damage whatsoever, whether caused by Owner’s negligence, fault, errors or omissions, strict liability, breach of contract, breach of warranty or other cause or causes whatsoever. Such special, indirect, incidental or consequential damages include, but are not limited to loss of profits, loss of savings or revenue, loss of anticipated profits, labor inefficiencies, idle equipment, home office overhead, and similar types of damages.

13.9.6 Nothing contained in this Contract or the Contract Documents shall create any contractual relationship with or cause of action in favor of a third party against the Owner.

13.9.7 No member or officer of the Board of Curators of the University incurs or assumes any individual or personal liability under the Contract or by reason of the default of the Owner in the performance of any terms thereof. Contractor releases and discharges all members or officers of the Board of Curators of the University from any liability as a condition of and as consideration for the award of the Contract to Contractor.

13.9.8 The Contractor hereby binds itself, its partners, successors, assigns and legal representatives to the Owner in respect to covenants, agreements and obligations contained in the Contract Documents. Contractor shall not assign the Contract or proceeds hereof without written consent of the Owner. If Contractor attempts to make such an assignment without such consent, it shall be void and confer no rights on third parties, and Contractor shall nevertheless remain legally responsible for all obligations under the Contract. The Owner’s consent to any assignment is conditioned upon Contractor entering into a written assignment which contains the following language: “it is agreed that the funds to be paid to the assignee under this assignment are subject to performance by the Contractor and to claims and to liens for services rendered or materials supplied for the performance of the Work required in said Contract in favor of all persons, firms, corporations rendering such services or supplying such materials.”

13.10 Debarment and Suspension Certification
The contractor certifies to the best of its knowledge and belief that it and its principals are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency in accordance with Executive Order 12549 (2/18/86).

ARTICLE 14
TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 Termination by Owner for Cause
14.1.1 In addition to other rights and remedies granted to Owner under the Contract Documents and by law, the Owner may terminate the Contract if the Contractor:
   .1 refuses or fails to supply enough properly skilled workers, superintendents, foremen, or managers;
   .2 refuses or fails to supply sufficient or proper materials;
   .3 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
   .4 disregards laws, ordinances, rules, or regulations or orders of a public authority having jurisdiction;
   .5 disregards the authority of the Owner’s Representative or Architect;
   .6 breaches any warranty or representations made by the Contractor under or pursuant to the Contract Documents;
   .7 fails to furnish the Owner with assurances satisfactory to the Owner evidencing the Contractor's ability to complete the Work in compliance with all the requirements of the Contract Documents;
   .8 fails after commencement of the Work to proceed continuously with the construction and completion of the Work for more than ten (10) days, except as permitted under the Contract Documents;
   .9 fails to maintain a satisfactory rate of progress with the Work or fails to comply with approved progress schedules; or
   .10 violates in any substantial way any provisions of the Contract Documents.

14.1.2 When any of the above reasons exist, the Owner may, without prejudice to any other rights or remedies of the Owner,
terminate this Contract by delivering a written notice of termination to Contractor and Contractor’s surety, and may:

1. take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
2. accept assignment of subcontracts pursuant to Paragraph 5.3; and
3. finish the Work by whatever reasonable method the Owner may deem expedient, including turning the Work over to the surety.

14.1.3 The Contractor, in the event of a termination under Section 14.1, shall not be entitled to receive any further payments under the Contract until the Work is completed in its entirety. Then, if the unpaid balance under the Contract shall exceed all expenses of the Owner in finishing the Work, including additional compensation for the Architect's services and expenses made necessary thereby, such excess will be paid to the Contractor; but, if such expenses of Owner to finish the Work shall exceed the unpaid balance, the Contractor and its surety shall be liable for, and shall pay the difference and any damages to the Owner. The obligation of the Contractor and its surety for payment of said amounts shall survive termination of the Contract.

14.1.4 In exercising the Owner's right to secure completion of the Work under any of the provisions hereof, the Owner shall have the right to exercise the Owner's sole discretion as to the manner, methods, and reasonableness of costs of completing the Work.

14.1.5 The rights of the Owner to terminate pursuant to Article 14.1 will be cumulative and not exclusive and shall be in addition to any other remedy provided by law or the Contract Documents.

14.1.6 Should the Contractor fail to achieve Final Completion of the Work within thirty (30) calendar days following the date of Substantial Completion, the Owner may exercise its rights under Article 14.1.

14.2 Suspension by the Owner for Convenience
14.2.1 The Owner may, without cause, order the Contractor in writing to suspend, delay, or interrupt the Work in whole or in part for such period of time as the Owner may determine.

14.2.2 An adjustment will be made to the Contract Sum for increases in the cost of performance of the Contract caused by suspension, delay or interruption. However, in the event of a suspension under this Article 14.2, Contractor hereby waives and forfeits any claims for payment of any special, indirect, incidental or consequential damages such as lost profits, loss of savings or revenue, loss of anticipated profits, idle labor or equipment, home office overhead, and similar type damages. No adjustment will be made to the extent:

1. that performance is, was, or would have been so suspended, delayed or interrupted by another cause for which the Contractor in whole or in part is responsible, or
2. that an equitable adjustment is made or denied under another provision of this Contract.

14.3 Owner's Termination for Convenience
14.3.1 The Owner may, at any time, terminate the Contract in whole or in part for the Owner's convenience and without cause. Termination by the Owner under this Paragraph shall be by a notice of termination delivered to the Contractor specifying the extent of termination and the effective date.

14.3.2 Upon receipt of a notice of termination for convenience, the Contractor shall immediately, in accordance with instructions from the Owner, proceed with performance of the following duties regardless of delay in determining or adjusting amounts due under this Paragraph:

1. cease operation as specified in the notice;
2. place no further orders and enter into no further subcontracts for materials, labor, services or facilities except as necessary to complete Work not terminated;
3. terminate all subcontracts and orders to the extent they relate to the Work terminated;
4. proceed to complete the performance of Work not terminated; and
5. take actions that may be necessary, or that the Owner may direct, for the protection and preservation of the terminated Work.

14.3.3 Upon such termination, the Contractor shall recover as its sole remedy payment for Work properly performed in connection with the terminated portion of the Work prior to the effective date of termination and for items properly and timely fabricated off the Project site, delivered and stored in accordance with the Owner's instructions and for all Owner approved claims, costs, losses and damages incurred in settlement of terminated contracts with Subcontractors and suppliers. The Contractor hereby waives and forfeits all other claims for payment and damages, including, without limitation, anticipated profits, consequential damages and other economic losses.

14.3.4 The Owner shall be credited for (1) payments previously made to the Contractor for the terminated portion of the Work, (2) claims which the Owner has against the Contractor under the Contract and (3) the value of the materials, supplies, equipment or other items that are to be disposed of by the Contractor that are part of the Contract Sum.

14.3.5 Upon determination by a court that termination of Contractor or its successor in interest pursuant to Paragraph 14.1 was wrongful, such termination will be deemed converted.
to a termination for convenience pursuant to Paragraph 14.3, and Contractor's sole and exclusive remedy for wrongful termination is limited to recovery of the payments permitted for termination for convenience as set forth in Paragraph 14.3.
SECTION 1.E
SPECIAL CONDITIONS

1. DEFINITIONS

a. "Drawings"

Drawings referred to in and accompanying Project Manual consist of Drawings prepared by and bearing name of below defined Architect, bearing **February 27, 2020 - 1501 Creekwood Parkway – Fitout Space for New WCH Ambulance Base.**

b. Architect:

PWArchitects, Inc.
2021 Forum Blvd., Ste. 101
Columbia, Mo. 65203
Phone: 573.449.2683

c. Mechanical, Plumbing, & Fire Protection Engineer:

Ross & Baruzzini
6 South Old Orchard Avenue
St. Louis, Mo. 63119
Phone: 314.918.8383

d. Electrical & Fire Alarm Engineer:

Antella Consulting Engineers, Inc.
1600 Genessee St., Ste. 260
Kansas City, Mo. 64102
Phone: 816.421.0950

e. Structural Engineer:

Crockett Engineering Consultants, LLC
1000 W. Nifong Blvd., Bldg. 1
Columbia, Mo. 65203
Phone: 573.447.0292

f. Civil Engineer:

Crockett Engineering Consultants, LLC
1000 W. Nifong Blvd., Bldg. 1
Columbia, Mo. 65203
Phone: 573.447.0292
g. Other Definitions: See Article 1. General Conditions.

2. SPECIAL SCHEDULING REQUIREMENTS

a. Special scheduling requirements supplemental to the bid form.

(1) Contractor shall perform all work in the designated areas within 153 calendar days.

(2) Work shall be continuous with no down time.

(3) Work shall be phased as indicated on drawings.

(4) Normal working hours are defined as weekdays between the hours of 7:30am and 4:30pm, or as approved by Owner’s Representative.

(5) Excessive Noisy Work hours - All interior concrete demolition work shall occur between 7:30 a.m. and 5:30 p.m. Such work shall be coordinated and approved at least forty-eight (48) hours in advance with Owner’s Representative.

b. Utility Shut-Downs, Outages, and Tie-ins – Contractor shall submit a Utility Outage Request Form including a written plan outlining the required shut-downs, outages, and tie-ins fourteen (14) calendar days prior to starting the work.

c. Refuse/Trash Removal and Material Delivery: As directed by Owner’s Representative

3. SCOPE OF WORK

a. The Contractor shall furnish all labor, materials, tools, equipment necessary for, and incidental to, construction of this project as indicated on Drawings and specified herein.

b. Work shall include everything requisite and necessary to finish work properly, notwithstanding that every item of labor or materials or accessories required to make project complete may not be specifically mentioned.

c. General Description of Work:

(1) Project consists of renovation of leased space in part of an existing pre-engineered metal building. The renovation will include two ambulance bays and associated living quarters for the ambulance staff on call. The living quarters will include four (4) sleeping rooms, a common kitchen and lounge area, and two (2) private bathrooms. Adjacent tenant spaces in the building are occupied.
(2) Demolition shall consist of removal of an existing single-story, wood-framed office/storage area, including a single-occupant restroom. Removal of existing MEP items including an electrical panel, misc. piping and wire, and lighting fixtures. Selective demolition at the rear wall as required for installation of new windows and louvers. Selective demolition at the concrete slab-on-grade for installation of new under-slab plumbing. Removal of paving as required for installation of a new water service.

(3) Architectural work shall consist of new flooring, new walls and finishes, new doors and door hardware, new windows and window treatments, new casework, construction of fire-rated shaftwall/wall assemblies (as noted on drawings), new kitchen casework, new kitchen appliances, new laundry appliances.

(4) Structural work shall consist of reinforcement of the existing pre-engineered steel building at the renovated tenant space, concrete repairs to the existing slab-on-grade, and light-gauge framing as required for the construction of the new (interior) living quarters; light-gauge framing will include the addition of a new second floor.

(5) Civil work shall consist of installation of a new water line serving the tenant space, re-grading/re-paving at the location of the new water line, and re-striping and moving an existing accessible parking space.

(6) Mechanical work shall consist of a new water service, new waste and supply plumbing, fixtures for the kitchen and (2) bathrooms, new HVAC system, gas piping as required for the new HVAC, a new vehicle exhaust system for the (2) ambulance bays, and a new sprinkler system.

(7) Electrical work shall consist of a new, relocated, electrical panel, new power and data outlets, new lighting, and a new fire alarm system.

4. LOCATION

Work shall be performed under this Contract at 1501 Creekwood Parkway, Suites 101/102, Columbia, Boone County, Missouri, 65202.

5. NUMBER OF CONSTRUCTION DOCUMENTS

a. The Owner's Representative will furnish the Contractor a copy of executed Contract and a complete set of Drawings and Specifications in pdf format.

b. The Owner will furnish explanatory and changed Drawings in pdf format to Contractor as issued during project.

c. Hard copy prints of any documents (bid or explanatory) will be printed at the
Contractor’s expense through a printer of their choosing.

6. SUBMITTALS

a. The Contractor shall submit for approval to the Architect, equipment lists and Shop Drawings, as expediently as possible. Failure of the Contractor to submit Shop Drawings in a timely manner will result in the Owner holding back Contractor payments. (See General Conditions)

b. The material and equipment lists shall be submitted and approved before any material or equipment is purchased and shall be corrected to as-built conditions before the completion of the project.

c. The Contractor shall submit electronic versions of all required Shop Drawings, material and equipment lists. The Contractor shall upload all Shop Drawings to a secure information sharing website determined by the Owner notifying the Owner and Consultant that these shop drawings are available for review. Refer to: https://projx4.cf.missouri.edu/projex for protocols for the use of this website. Each submittal shall have the General Contractors digital stamp affixed to the first page signifying their review and acceptance. Review comments, approvals, and rejections will be posted on this same site with notification to the contractor. Submittals requiring a professional seal shall be submitted hard copy with a manual seal affixed.

(1) The Contractor shall identify each submittal item with the following:

(a) Project Title and Location
(b) Project Number
(c) Supplier’s Name
(d) Manufacturer’s Name
(e) Contract Specification Section and Article Number
(f) Contract Drawing Number
(g) Acrobat file name: Spec Section_Times Submitted-Spec Title: 033000_01-Cast In Place Concrete.pdf

(2) Reference the accompanying Shop Drawing and Submittal Log at the end of this section (1.E.3) for required submittal information.

d. The Contractor shall submit to the Architect two (2) bound copy and one pdf copy of all required Operating Instructions and Service Manuals for the Architect’s and the Owner’s sole use prior to completing 50% of the adjusted contract. Payments beyond 50% of the contract amount may be withheld until all Operating Instructions and Service Manuals are received as referenced in the accompanying Operating Instructions and Service Manual Log at the end of this section (1.E.4).

(1) Warranties: The Contractor shall provide a cover sheet for each warranty with
the following:

a. The word “Warranty at the top of the page in large type, all capitals.
b. Project Number
c. Project Title and Location
d. Specification Section Number and Name
e. List of the specific equipment covered by the warranty followed by a table listing:
   i. Equipment Tag
   ii. Equipment Model Number
   iii. Equipment Serial Number.
f. See the Warranty Cover Page Template included elsewhere in this document.

e. The Contractor shall submit to the Owner’s Representative all items referenced in the accompanying Closeout Log (1.E.5) within 30 days following substantial completion of the work. The Owner’s Representative will maintain the closeout log and include as an agenda item at all coordination meetings.

7. NOTIFICATION

a. Before beginning Demolition Work or service outages, the Contractor shall provide, at minimum, seventy-two (72) hours advance notice to Owner’s Representative for purpose of verifying utility locations including, but not limited to, gas, telecommunications, electric, water, steam, sewer, and nitrogen. Contractor shall minimize the number of outages, minimize the length of outages and related work shall be continuous until the utility is restored.

8. USE OF PREMISES

a. Access: Access to construction site shall be as indicated on Drawings and as directed by the Owner's Representative.

b. Parking: The Contractor shall be allowed for eight (8) vehicles to park in location directed by the Owner’s Representative.

c. Storage of materials: The Contractor shall store all materials within project limits. The Contractor shall confine apparatus, materials, and operation of workers to location established by the Owner's Representative. The Contractor shall not unreasonably encumber premises with materials.

d. Utilities: Drinking water, water required to carry on work, and 120-volt electrical power required for small tool operation may be obtained without cost to the Contractor from existing utilities at locations designated by the Owner's Representative. Provisions for obtaining power, including temporary extensions, shall be furnished and maintained by the Contractor. Upon completion of work
such extensions shall be removed and any damage caused by use of such extensions shall be repaired to satisfaction of the Owner's Representative, at no cost to the Owner.

e. Restroom: The Contractor shall provide and maintain, in a sanitary condition, chemical type portable toilet facilities at work site for use by his personnel. Toilets and toilet location shall be subject to approval by the Owner's Representative.

f. The use of tobacco products is prohibited at the University of Missouri and all properties owned, operated, leased or controlled by the University of Missouri. Violation of the policy is defined as the use of any tobacco products, including e-cigarettes.

g. Landfill: The Contractor shall not use the Owner’s landfill. Dumping or disposal of excavated or demolition materials on Owner’s property shall not be permitted. The Contractor shall remove and legally dispose of excavated or demolished materials off the Owner’s property.

h. Care of Project Work Site: The contractor shall be responsible for maintaining the construction site in a reasonably neat and orderly condition by regular cleaning and mowing of the premises as determined by the Owner’s Representative.

i. Discharge to Sewer Request: The University of Missouri’s MS4 permit and NPDES Storm Water Discharge Permits along with the City of Columbia’s POTW Operating Permit as well as local ordinances, and state and federal environmental regulations prohibit hazardous materials from being disposed into either the storm water or sanitary sewer systems. Unless specifically approved, all chemical products such as paints, dyes, lawn care products, maintenance products, and oil is prohibited from drain disposal. Any product, including contaminated water, being discarded into the storm water or sanitary sewer systems requires written approval from the Owner through a formal “Discharge to Sewer Request” form obtained at Discharge to Sewer Request Form. The contractor should submit the form to the Owner’s Representative, not to the Department of Environmental Health and Safety as the form indicates.

j. All concrete waste material including washout water shall be totally contained and removed from the Owner’s property.

9. PROTECTION OF OWNER'S PROPERTY

a. The Contractor shall be responsible for repair of damage to building exterior and interior, drives, curbs, streets, walks, grass, shrubbery and trees, which was caused by workmen or equipment employed during progress of work. All such repairs shall be made to satisfaction of the Owner's Representative, at no cost to the Owner, or reimburse the Owner if the Owner elects to make repairs.

b. Construction Project Fencing:
(1) Project worksite shall be kept continuously protected with, at minimum, a temporary portable fence constructed of woven wire or plastic woven fencing not less than five (5) feet in height and supported by metal tee posts spaced not more than ten (10) feet apart and imbedded in five (5) gallon buckets of concrete or an equivalent method of support. In lieu of five-gallon buckets of concrete, metal posts may be driven into ground or asphalt. Fencing shall have reflective devices, such as, tape, ribbon, and/or be painted in a bright fluorescent color. Portions of fence shall be reinstalled when work activities cease and during all non-work periods.

(2) Using existing landmarks, lamp posts, trees or other Owner property for support of fencing is strictly prohibited unless a written waiver is obtained from Owner's Representative.

(3) Use of ribbon, snow fence, chicken wire, rope, and wooden barricades as fencing is prohibited.

(4) Fencing shall be maintained in an "as-installed" condition throughout the life of the project.

(5) The Contractor may use used fencing provided it is in good condition and is satisfactory to the Owner's Representative.

10. SUBSTITUTIONS and EQUALS

a. Substitutions are defined in General Conditions article 3.11.8 for and Equals are defined General Conditions Article 3.12.

b. Use of materials, products or equipment other than those named and described in the Contract Documents are substitutions and/or equal. Substitutions and/or equals submitted during the bidding period shall be received by both the Architect and the Owner at least ten calendar days prior to the date for receipt of bids. To be considered, bidder's proposal shall include a complete description of the proposed substitution and/or equal and a comparison of significant qualities of the proposed substitution and/or equal with those specified including drawings, performance and test data, and other information necessary for an evaluation. The Architect's decision on the approval or disapproval of a proposed substitution and/or equal shall be final.

c. If the Architect and Owner approve a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approval made in any other manner.

d. No substitutions and/or equal will be allowed for the following items:
11. PERMITS

a. The Owner’s Representative shall secure University Authority Having Jurisdiction building permits required for the project and shall provide a list of required inspections to the Contractor. The Contractor shall work with the Owner’s Representative to coordinate and provide reasonable scheduling and access to the Work for the Owner’s inspection.

b. Before commencement of Boilers, Water Heaters or Pressure Vessels the Contractor must obtain an installation permit from the State of Missouri, Division of Fire Safety, Boiler and Pressure Unit as required by 11 CSR 40-2.010 through 11 CSR 40-2.065. The permit applications are available at [http://www.dfs.dps.mo.gov/programs/bpv/](http://www.dfs.dps.mo.gov/programs/bpv/).

c. Energized Work Permit

Contractors are required to comply with applicable Safety and Health regulations such as OSHA, NFPA, and EPA. Energized work is to be avoided unless absolutely necessary. Live parts shall be de-energized before working on or near them unless an exception is warranted per 2004 for later edition of NFPA 70E. When working on or near live parts (including testing and troubleshooting), contractor shall select the appropriate Personal Protective Equipment and follow an electrical work safety program per NFPA 70E. If unable to determine the necessary level of protection using the NFPA 70E tables, an Arc Flash Hazard Electrical Analysis must be performed by a Professional Electrical Engineer licensed in the state of Missouri.

A copy of the Contractor’s completed Energized Electrical Work Permit shall be submitted to the Owner’s Representative before any Energized Work begins. Contractors may be required to submit copies of their Safety Program to the Owner’s Representative upon request.

12. PRE-BID INSPECTION

All pre-bid inspections of work areas shall be scheduled with pre-bid inspection guide, telephone: (573) 882-2228.

13. ROOF WARRANTY REQUIREMENT

a. Landlord has an existing roof warranty on roof of the building which the Owner is attempting to procure. Arrangements will be made with the contractor for penetrations through the roof. If available, the Contractor shall use a licensed applicator of existing roofing system to make and repair roof penetrations in order for the Owner's existing warranty to remain in full force and effect.
14. MODIFICATIONS TO INFORMATION TO BIDDERS

a. Information to Bidders:

   (1) Referenced Information to Bidders, Page IFB/6.
   
   Add new Article 15.9.2 as follows:

   **15.9.2.1** Within 48 hours of the receipt of bids, the apparent low bidder shall submit to the Director of Facilities Planning and Development an “Affidavit of Supplier Diversity Participation” for every diverse subcontractor or supplier the bidder intends to award work to on the contract. The affidavit will be signed by both the bidder and the diverse firm.

15. PROJECT SCHEDULING

a. The project scheduling specification for the project are included immediately after the Special Conditions. For this project the Contractor shall meet the following scheduling requirements.

   Contractor is responsible for the schedule and must comply with the Owner’s requirements. See Contractor Schedule Specification included in these documents.

16. PROJECT COORDINATION

a. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.

   (1) Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

   (2) Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.

   (3) Make provisions to accommodate items scheduled for later installation.

17. VALUE ENGINEERING

a. After execution of the contract with the successful contractor, the Owner will entertain value engineering initiatives from the contractor. These initiatives may include modifications to the drawings and specifications. The Owner will not entertain modifications that affect the functions or characteristics of the project,
including but not limited to: service life of systems or components, economy of operations, ease of maintenance, appearance, or design and safety standards.

b. Once a value initiative is recommended to the Owner’s Representative, the Owner’s Representative will determine if the proposal deserves further merit. If not, the Contractor will be notified the proposal has not been accepted. If the Owner’s Representative determines the proposal should be considered, a team will be assembled consisting of the Owner’s Representative, Architect, Contractor and other parties that may be necessary to appropriately review the initiative. The team will review the initiative and determine whether to proceed with a value engineering joint proposal. The Owner and Contractor must jointly agree to the merit of any value engineering initiative before the preparation of the value engineering joint proposal. The Owner will not be liable for the failure to accept any value engineering initiative.

c. If the Owner and the Contractor jointly agree to the initiative, the Contractor shall prepare the value engineering joint proposal. The proposal shall contain, at a minimum, the following:

(1) An itemized list of existing contract requirements recommended to be changed and proposed language for modification.

(2) All construction documents and computations necessary for a thorough and expeditious evaluation.

(3) A detailed estimate of the cost of performing the work under the existing contract and under the proposed changes, including the cost of implementing the changes.

(4) Estimate of costs the Owner may incur related to the proposed changes such as maintenance and operating cost.

(5) Changes to the project schedule.

(6) Estimate of any other project cost that may be incurred to develop the recommended changes, including Owner’s professional fees.

d. The Contractor shall submit the value engineering joint proposal to the Owner’s Representative. The Contractor will be notified if the proposals have been accepted or if clarifications and/or negotiations are necessary.

e. If the proposal is rejected, the issue is dismissed, and each party is responsible for their own cost incurred.

f. If the proposal is accepted in whole or in part, the Owner’s Representative will prepare a Change Order to implement the proposal in the project.
(1) The net savings for the proposal will be calculated by subtracting from the total construction cost savings, the Owner’s cost associated with the proposal including professional fees. The Owner will be the sole judge of the acceptability of a proposal, and the estimated net savings from the adoption of all or any part of the proposal. The Owner reserves the right to disregard the contract bid prices and/or the Contractor’s breakdown of cost, if, in the Owner’s judgment, such prices do not represent a fair measure of the value of the work to be performed or deleted.

(2) Savings resulting solely from the elimination or reduction in quantity of a bid item will not be considered as a value engineering initiative.

(3) Value Engineering initiatives will only be considered by the Owner within the first 150 days of the contract.

(4) For those initiatives accepted by the Owner, the Contractor will be paid 50 percent of the net savings.

(5) Upon acceptance of a value engineering joint proposal, any restriction imposed by the Contractor on its use or on disclosure of the information shall become void, and the Owner thereafter shall have the right to use all or any part of the proposal without obligation or compensation of any kind to the Contractor.

18. MECHANICAL, ELECTRICAL, PLUMBING (MEP) PRE-INSTALLATION MEETING(S)

a. Before the start of MEP installation, the Owner’s Representative will convene an MEP pre-installation meeting. Meeting participants to include contractor (including MEP subcontractors), Owner’s Representative and additional contractor and University operational staff invited by the Owner’s Representative. Topics will include underground rough-ins, steam piping, chilled water piping, sprinkler piping, hot water piping, electrical system, duct, telephone/data wiring, control wiring. Additional meetings will be conducted as required for the review of coordination drawings and scope specific installations. Cross section drawings of corridor ceilings and other congested areas will be of highest priority and will be reviewed prior to the start of installations in the affected areas. Meeting minutes and sign-up sheet will be transcribed by contractor and distributed to attendees.

19. PROJECT MANAGEMENT/COMMUNICATION REQUIREMENTS

a. The Contractor shall use a current industry standard (Primavera, Microsoft Project, etc.) project scheduling software which provides as a minimum: Critical paths, milestones, estimated and actual start and completion dates, scheduled vs. actual progress, and detailed task and subtask breakdown. The following schedules shall
be provided as a minimum and kept current: Overall project schedule, four- (4-) week look-ahead, and two- (2-) week look-ahead.

20. SAFETY PRECAUTIONS AND PROGRAMS

   a. The contractor shall provide Emergency Contact Information for the Contractor’s on-site staff and home office management as well as contact information for all major subcontractor personnel. This information shall contain business and personal phone numbers for each individual for contact during or after hours in case of an emergency. This information shall be submitted within 15 days of the Notice to Proceed.

21. WARRANTY WALKTHROUGH

Contractor shall attend a walk-thru with the Owner at 11 months after acceptance to review and document any warranty items to be addressed as part of the 12-month warranty stated in article 3.1 of the General Conditions.

END OF SECTION
Contractor Schedule

1. GENERAL
   a) Time is of the essence for this contract.
      The time frames spelled out in this contract are essential to the success of this project. The University understands that effective schedule management, in accordance with the General Conditions and these Special Conditions is necessary to insure that the critical milestone and end dates spelled out in the contract are achieved.

b) Related Documents
   Drawings and general provisions of the Contract, including General Conditions’ Article 3.17 shall apply to this Section.

c) Stakeholders
   A Stakeholder is anyone with a stake in the outcome of the Project, including the University, the University Department utilizing the facility, the Design Professionals, the Contractor and subcontractors.

d) Weather
   (1) Contractor acknowledges that there will be days in which work cannot be completed due to the weather, and that a certain number of these lost days are to be expected under normal weather conditions in Missouri.
   (2) Rather than speculate as to what comprises “normal” weather at the location of the project, Contractor agrees that it will assume a total of 44 lost days due to weather over the course of a calendar year and include same in its as planned schedule. For projects of less than a calendar year, lost weather days should be prorated for the months of construction in accordance with the following schedule.
   (3) Anticipated weather days for allocation/proration only. For projects lasting 12 months or longer, the 44 days per year plus whatever additional months are included will constitute normal weather.

| Jan – 5 days | Feb – 5 days | Mar – 4 days | Apr – 4 days |
| May – 3 days | Jun – 3 days | Jul – 2 days | Aug – 2 days |
| Sep – 3 days | Oct – 4 days | Nov – 4 days | Dec – 5 days |

2. SCHEDULING PROCESS
   a) The intent of this section is to ensure that a well-conceived plan, that addresses the milestone and completion dates spelled out in these documents, is developed with input from all stakeholders in the project. Input is limited to all reasonable requests that are consistent with the requirements of the contract documents, and do not prejudice the Contractor’s ability to perform its work consistent with the contract documents.
   Further, the plan must be documented in an understandable format that allows for each stakeholder in the project to understand the plan for the construction and/or renovation contained in the Project.

b) Contractor Requirements
   (1) Schedule Development
      Contractor shall prepare the Project Schedule using Primavera SureTrack or P3, Microsoft Project, Oracle P6, or other standard industry scheduling software, approved by the Owner’s Representative.
(2) Schedule Development
Within 2 weeks of the NTP, contractor shall prepare a schedule, preferably in CPM format, but in detailed bar chart format at a minimum, that reflects the contractor’s and each subcontractor’s plan for performing the contract work.

Contractor shall review each major subcontractor’s schedule with the sub and obtain the subcontractor’s concurrence with the schedule, prior to submitting to the University.

(3) Schedule Updates.
(a) Schedule Updates will be conducted once a month, at a minimum. Actual Start and Finish dates should be recorded regularly during the month. Percent Complete, or Remaining Duration shall be updated as of the data date, just prior to Contractor’s submittal of the update data.
(b) Contractor will copy the previous month’s schedule and will input update information into the new monthly update version.
(c) Contractor will meet with the Owner’s Representative to review the draft of the updated schedule. At this meeting, Owner’s Representative and Contractor will:
   (i) Review out of sequence progress, making adjustments as necessary,
   (ii) Add any fragnets necessary to describe changes or other impacts to the project schedule and
   (iii) Review the resultant critical and near critical paths to determine any impact of the occurrences encountered over the last month.

(4) Schedule Narrative
After finalization of the update, the Contractor will prepare a Narrative that describes progress for the month, impacts to the schedule and an assessment as to the Contractor’s entitlement to a time extension for occurrences beyond its control during the month and submit in accordance with this Section.

(5) Progress Meetings
(a) Review the updated schedule at each monthly progress meeting. Payments to the Contractor may be suspended if the progress schedule is not adequately updated to reflect actual conditions.
(b) Submit progress schedules to subcontractors to permit coordinating their progress schedules to the general construction work. Include 4 week look ahead schedules to allow subs to focus on critical upcoming work.

3. CRITICAL PATH METHOD (CPM)
a) This Section includes administrative and procedural requirements for the critical path method (CPM) of scheduling and reporting progress of the Work.
b) Refer to the General and Special Conditions and the Agreement for definitions and specific dates of Contract Time.
c) Critical Path Method (CPM): A method of planning and scheduling a construction project where activities are arranged based on activity relationships and network calculations determine when activities can be performed and the critical path of the Project.
d) Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall project duration.
e) Network Diagram: A graphic diagram of a network schedule, showing the activities and activity relationships.
f) Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling, the construction project. Activities included in a construction schedule consume time and resources.

g) Critical activities are activities on the critical path.

h) Predecessor activity is an activity that must be completed before a given activity can be started.

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

j) Float or Slack Time: The measure of leeway in activity performance. Accumulative float time is not for the exclusive use or benefit of the Owner or Contractor but is a project resource available to both parties as needed to meet contract milestones and the completion date.

k) Total float is herein defined as the measure of leeway in starting or completing an activity without adversely affecting the planned project completion date.

l) Weather: Adverse weather that is normal for the area must be taken into account in the Contractor's Project Schedule. See 1.d.3, above.

m) Force Majeure Event: Any event that delays the project but is beyond the control and/or contractual responsibility of either party.

n) Schedule shall include the following, in addition to Contractor’s work.

   (1) Phasing: Provide notations on the schedule to show how the sequence of the Work is affected by the following:

   (a) Requirements for phased completion and milestone dates.
   (b) Work by separate contractors.
   (c) Work by the Owner.
   (d) Coordination with existing construction.
   (e) Limitations of continued occupancies.
   (f) Uninterruptible services.
   (g) Partial occupancy prior to Substantial Completion.

o) Area Separations: Use Activity Codes to identify each major area of construction for each major portion of the Work. For the purposes of this Article, a "major area" is a story of construction, a separate building, or a similar significant construction element.

4. TIME EXTENSION REQUEST

a) Refer to General Conditions of the Contract for Construction, Article 4.7 Claims for Additional Time.

b) Changes or Other Impacts to the Contractor’s Work Plan

   The Owner will consider and evaluate requests for time extensions due to changes or other events beyond the control of the Contractor on a monthly basis only, with the submission of the Contractor’s updated schedule, in conjunction with the monthly application for payment. The Update must include:

   (1) An activity depicting the event(s) impacting the Contractors work plan shall be added to the CPM schedule, using the actual start date of the impact, along with actually required predecessors and successors.

   (2) After the addition of the impact activity(ies), the Contractor will identify subsequent activities on the critical path, with finish to start relationships that can be realistically adjusted to overlap using good, standard construction practice.

   (a) If the adjustments above result in the completion date being brought back within the contract time period, no adjustment will be made in the contract time.

   (b) If the adjustments above still result in a completion date beyond the contract completion date, the delay shall be deemed excusable and the contract completion date shall be extended by the number of days indicated by the analysis.
(c) Contractor agrees to continue to utilize its best efforts to make up the time caused by the delays. However, the Contractor is not expected to expend costs not contemplated in its contract, in making those efforts.

c) Questions of compensability of any delays shall be held until the actual completion of the project. If the actual substantial completion date of the project based on excusable delays, excluding weather delays, exceeds the original contract completion date, AND there are no delays that are the responsibility of the contractor to consider, the delays days shall be considered compensable. The actual costs, if any, of the Contractor’s time sensitive jobsite supervision and general conditions costs, shall be quantified and a change order issued for these costs.
WARRANTY

Project No: CP200101
Project Name: 1501 Creekwood Parkway – Fitout Space for New WCH Ambulance Base
Project Location: 1501 Creekwood Parkway; Columbia, Mo.
Section: 23 3423 Fans and Ventilators
Equipment covered: Exhaust Fans

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NOTE TO CONTRACTOR:

Information shown is for example only. Edit Section, Equipment Covered, Tag, Model Number, and Serial Number as required.
**SHOP DRAWING AND SUBMITTAL LOG**

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**Project Number:** MU No. CP 200101 / PWA 201918  
**Contractor:**

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**Contractor:**  

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# Equipment List

Refer to plan schedules for initial population of equipment, additional equipment to be added as needed.

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## SECTION 1.F

### INDEX OF DRAWINGS

Drawings referred to in and accompanying Project Manual consist of following sheets dated February 27, 2020.

**CP200101 - 1501 Creekwood Parkway – Fitout Space for New WCH Ambulance Base**

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Missouri
Division of Labor Standards
WAGE AND HOUR SECTION

MICHAEL L. PARSON, Governor

Annual Wage Order No. 26
Section 010
BOONE COUNTY

In accordance with Section 290.262 RSMo 2000, within thirty (30) days after a certified copy of this Annual Wage Order has been filed with the Secretary of State as indicated below, any person who may be affected by this Annual Wage Order may object by filing an objection in triplicate with the Labor and Industrial Relations Commission, P.O. Box 599, Jefferson City, MO 65102-0599. Such objections must set forth in writing the specific grounds of objection. Each objection shall certify that a copy has been furnished to the Division of Labor Standards, P.O. Box 449, Jefferson City, MO 65102-0449 pursuant to 8 CSR 20-5.010(1). A certified copy of the Annual Wage Order has been filed with the Secretary of State of Missouri.

Original Signed by
Taylor Burks, Director
Division of Labor Standards

Filed With Secretary of State: ____________________________ March 8, 2019

Last Date Objections May Be Filed: April 8, 2019

Prepared by Missouri Department of Labor and Industrial Relations
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<th>Basic Hourly Rates</th>
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<td>Asbestos Worker</td>
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*The Division of Labor Standards received less than 1,000 reportable hours as required by RSMo 290.257.4(b).
Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center, in accordance with RSMo 290.257.2.

**Annual Incremental Increase
<table>
<thead>
<tr>
<th>OCCUPATIONAL TITLE</th>
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<tbody>
<tr>
<td>Carpenter</td>
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<td>Group IV</td>
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</tbody>
</table>

Use Heavy Construction Rates on Highway and Heavy construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(3).

Use Building Construction Rates on Building construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(2).

If a worker is performing work on a heavy construction project within an occupational title that is not listed on the Heavy Construction Rate Sheet, use the rate for that occupational title as shown on the Building Construction Rate Sheet.

*The Division of Labor Standards received less than 1,000 reportable hours as required by RSMo 290.257.4(b). Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center, in accordance with RSMo 290.257.2.
SECTION 01 2200
UNIT PRICES

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. List of unit prices, for use in preparing Bids.
   B. Measurement and payment criteria applicable to Work performed under a unit price payment method.
   C. Defect assessment and non-payment for rejected work.

1.02 COSTS INCLUDED
   A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.03 UNIT QUANTITIES SPECIFIED
   A. Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

1.04 MEASUREMENT OF QUANTITIES
   A. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.
   B. Take all measurements and compute quantities. Measurements and quantities will be verified by Owner's Representative.
   C. Assist by providing necessary equipment, workers, and survey personnel as required.
   D. Measurement Devices:
      1. Weigh Scales: Inspected, tested and certified by the applicable state Weights and Measures department within the past year.
      2. Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.
      3. Metering Devices: Inspected, tested and certified by the applicable state department within the past year.
   E. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
   F. Measurement by Area: Measured by square dimension using mean length and width or radius.
   G. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.
   H. Stipulated Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.
   I. Perform surveys required to determine quantities, including control surveys to establish measurement reference lines. Notify Architect prior to starting work.
   J. Contractor's Responsibilities: Sign surveyor's field notes or keep duplicate field notes, calculate and certify quantities for payment purposes.

1.05 PAYMENT
   A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.
B. Payment will not be made for any of the following:
   1. Products wasted or disposed of in a manner that is not acceptable.
   2. Products determined as unacceptable before or after placement.
   3. Products not completely unloaded from the transporting vehicle.
   4. Products placed beyond the lines and levels of the required Work.
   5. Products remaining on hand after completion of the Work.

1.06 UNIT PRICES
A. Only a single unit price shall be given and it shall apply for either MORE or LESS work than that indicated on Drawings and called for in Specifications as indicatd to be included in Base Bid and/or Alternates. In the event that more or less units than so indicated is actually furnished, Change Orders will be issued for increased or decreased amounted as approved by the Owner.

B. Contractor understands that the Owner will not be liable for any Unit Price or any amount in excess of Base Bid and any Alternate(s) accepted at time of award of Contract, except as expressed in written Change Orders duly executed and delivered by Owner's Representative.

1.07 DEFECT ASSESSMENT
A. Replace Work, or portions of the Work, not complying with specified requirements.

B. If, in the opinion of Owner's Representative, it is not practical to remove and replace the Work, Owner's Representative will direct one of the following remedies:
   1. The defective Work may remain, but the unit price will be adjusted to a new unit price at the discretion of Owner's Representative.
   2. The defective Work will be partially repaired to the instructions of the Owner's Representative, and the unit price will be adjusted to a new unit price at the discretion of Owner's Representative.

C. The individual specification sections may modify these options or may identify a specific formula or percentage price reduction.

D. The authority of Owner's Representative to assess the defect and identify payment adjustment is final.

1.08 SCHEDULE OF UNIT PRICES
A. Item: Alternate Flooring Adhesive; Section 09 0561 Common Work Results for Flooring Preparation.

B. Item: Remedial Floor Coating; Section 09 0561 Common Work Results for Flooring Preparation.

PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION - NOT USED

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Selective demolition of building elements for alteration purposes.
B. Abandonment and removal of existing utilities and utility structures.
C. Salvage designated items for Owner.
D. Demolition of all items requisite and necessary to allow for proper construction of new work, notwithstanding every item of labor or materials or accessories required to make project complete may not be specifically mentioned.
E. Coordinate this work with all new construction.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS
A. See Division One for Submittal Procedures.
B. Salvage Inventory: Submit list of items to be removed and salvaged. Deliver to Owner prior to demolition.
C. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction and site improvements. Include finish surfaces and other items that might be misconstrued as damage caused by demolition operations.
D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.04 PROJECT CONDITIONS
A. Tenant spaces directly adjacent to designated demolition area will be occupied. Conduct selective demolition so operations of occupied spaces will not be disrupted.
   1. Provide not less than 72 hours notice of activities that will affect operations of adjacent occupied buildings.
   2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
   3. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission of Owner.
B. On site storage or sale of removed items or materials is not permitted.

1.05 QUALITY ASSURANCE
A. Demolition Firm Qualifications: Company specializing in the type of work required.
   1. Minimum of 5 years of documented experience.
B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
PART 2 PRODUCTS – NOT USED
PART 3 EXECUTION

3.01 SCOPE

A. Remove portions of building designated on drawings and all items requisite and necessary to allow for proper construction of new work.
B. Remove paving and curbs as required to accomplish new work.
C. Remove other items indicated, for salvage and relocation.
D. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with all requirements specified in Division One.
B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
   3. Maintain fire watch during and for at least 24 hours after flame cutting operations.
   4. Maintain adequate ventilation when using cutting torches.
   5. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
   6. University has a Title V Permit that states that no fugitive particulate matter emissions shall go beyond the premise of origin in the quantities that the particulate matter may be found on surfaces beyond the property line of origin. Conduct demolition operations to comply with University’s Title V Permit regulations.
   7. Comply with applicable requirements of NFPA 241.
   8. Use of explosives is not permitted.
   9. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   11. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   12. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   13. Do not close or obstruct roadways or sidewalks without permit.
   14. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
   15. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
C. Do not begin removal until receipt of notification to proceed from Owner.
D. Do not begin removal until built elements to be salvaged or relocated have been removed.
E. Protect existing structures and other elements that are not to be removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.
F. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

G. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

### 3.03 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

### 3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.

1. Verify that construction and utility arrangements are as indicated.

2. Report discrepancies to Architect before disturbing existing installation.

3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Remove existing work as indicated and as required to accomplish new work.

1. Remove items indicated on drawings.

C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.

1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.

2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.

3. Verify that abandoned services serve only abandoned facilities before removal.

4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

D. Protect existing work to remain.

1. Prevent movement of structure; provide shoring and bracing if necessary.

2. Perform cutting to accomplish removals neatly and as specified for cutting new work.

3. Repair adjacent construction and finishes damaged during removal work.

4. Patch as specified for patching new work.

### 3.05 SALVAGE SCHEDULE

A. General: Owner will remove a number of items before Contractor begins work. Items left after that week, becomes the Contractor's obligation to remove as part of demolition.
B. Remove and salvage items noted on drawings for reuse in the project either in same location or other locations as noted on the drawings. Carefully detach from existing construction, in a manner to prevent damage and deliver to and store on site at designated areas, ready for reuse. Include fasteners or brackets needed for reattachment elsewhere. Protect all removed items noted for reuse from damage.

3.06 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
B. Related Sections:
   1. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.
   2. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.
B. Design Mixtures: For each concrete mixture.
C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.

1.3 INFORMATIONAL SUBMITTALS
A. Material certificates.
B. Material test reports.

1.4 QUALITY ASSURANCE
A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
C. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
   2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
D. Concrete Testing Service: Owner engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS
A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 STEEL REINFORCEMENT
A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice.

2.3 CONCRETE MATERIALS
A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
   1. Portland Cement: ASTM C 150 Type I/II, gray. Supplement with the following:
      a. Fly Ash: ASTM C 618, Class F or C.
      b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
B. Normal-Weight Aggregates: ASTM C 33, graded.
   1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) nominal.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

2.4 ADMIXTURES
A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 VAPOR RETARDERS
A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.6 CURING MATERIALS
A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

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

D. Water: Potable.

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

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

G. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
   1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
   1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 RELATED MATERIALS


B. Concure Systems Crack Fill Binder
   1. Acceptable Products:
      a. Concure Systems 1618 E. Briarwood Terrace, Phoenix, AZ 85048
         1) Contact: Emil Pikula Cell – (480) 820-7171, Fax (480) 820-7787, E-mail: epikula@cox.net

2.8 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

B. Cementitious Materials: 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 20 percent.

C. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing admixture in concrete, as required, for placement and workability.

D. Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: As required by prints at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50 – footings; 0.45 – all other mixes
3. Slump Limit: 4 inches (125 mm) or 8 inches (200 mm for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
5. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
   a. Add water vapor reducing admixture per manufacturers specified dosage rate to ready mix truck at the batch plant, or jobsite before discharge, mix rapidly for 7 minutes. (Follow Manufacturer’s Instructions).

2.9 FABRICATING REINFORCEMENT
   A. Fabricate steel reinforcement according to CRSI’s "Manual of Standard Practice."

2.10 CONCRETE MIXING
   A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION
3.1 FORMWORK
   A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
   B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
   C. Chamfer exterior corners and edges of permanently exposed concrete.

3.2 EMBEDDED ITEMS
   A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS
   A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer’s written instructions.
   1. Lap joints 6 inches (150 mm) and seal with manufacturer’s recommended tape.

3.4 STEEL REINFORCEMENT
   A. General: Comply with CRSI’s "Manual of Standard Practice" for placing reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
3.5 JOINTS
A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
E. Waterstops: Install in construction joints and at other joints indicated according to manufacturer's written instructions.

3.6 CONCRETE PLACEMENT
A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
C. Cold-Weather Placement: Comply with ACI 306.1.
D. Hot-Weather Placement: Comply with ACI 301.

3.7 FINISHING FORMED SURFACES
A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces not exposed to public view.
B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces exposed to public view.
C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture
matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS
A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
   2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch (3.2 mm) at the gymnasium floor and 1/4" (6.4mm) at all other locations.

3.9 CONCRETE PROTECTING AND CURING
A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
      a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 CONCRETE SURFACE REPAIRS
A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.11 FIELD QUALITY CONTROL
A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION 03 3000
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete block.
B. Mortar.
C. Accessories.

1.02 REFERENCE STANDARDS


1.03 SUBMITTALS

A. See Division One for Submittal Procedures.
B. Product Data: Provide data for masonry units, mortar, and masonry accessories.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units, as indicated on drawings for specific locations.
   2. Load-Bearing and Non-Load-Bearing Units: ASTM C90, lightweight.
      a. Solid block, as indicated.
      b. Exposed Faces: Manufacturer's standard color and texture.

2.02 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I.
   1. Not more than 0.60 percent alkali.
B. Hydrated Lime: ASTM C207, Type N.
C. Mortar Aggregate: ASTM C144.
D. Water: Clean and potable.

2.03 MORTAR MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
   1. All Masonry Block: Type N.
B. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
C. Mixing: Use mechanical batch mixer and comply with referenced standards.
PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.
B. Verify that related items provided under other sections are properly sized and located.
C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 COLD AND HOT WEATHER REQUIREMENTS

A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.
B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

3.03 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.
B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
C. Concrete Masonry Units:
   1. Bond: Running.
   2. Coursing: One unit and one mortar joint to equal 8 inches.

3.04 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
B. Lay hollow masonry units with face shell bedding on head and bed joints.
C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
D. Remove excess mortar and mortar smears as work progresses.
E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
G. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.

3.05 CLEANING

A. Clean soiled surfaces with cleaning solution.

END OF SECTION
SECTION 05 1200
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes structural steel and grout.
B. Related Sections:
   1. Division 05 Section "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
   2. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

1.2 DEFINITIONS
A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
B. Moment Connections: Type FR, fully restrained.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings: Show fabrication of structural-steel components.

1.4 INFORMATIONAL SUBMITTALS
A. Qualification Data: For qualified Installer, fabricator, and testing agency.
B. Welding certificates.
C. Mill test reports for structural steel, including chemical and physical properties.
D. Source quality-control reports.

1.5 QUALITY ASSURANCE
A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
B. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
   2. AISC 360.
   3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS
A. W-Shapes: ASTM A 572/A 572M, Grade 50 (345).
B. Channels, Angles, M, S-Shapes: ASTM A 36/A 36M.
C. Plate and Bar: ASTM A 36/A 36M.
D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS
A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.

B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
   1. Finish: Plain.

C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

D. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
   2. Finish: Plain.

E. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
   1. Finish: Plain.

F. Threaded Rods: ASTM A 36/A 36M.
   1. Finish: Plain.

2.3 PRIMER
   A. Primer: Fabricator's standard lead- and chrome-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.4 GROUT
   A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION
   A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

   B. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

2.6 SHOP CONNECTIONS
   A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
      1. Joint Type: Snug tightened.

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

2.7 SHOP PRIMING
   A. Shop prime steel surfaces except the following:
      1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
      2. Surfaces to be field welded.
      3. Surfaces to be high-strength bolted with slip-critical connections.
      4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
      5. Galvanized surfaces.

   B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
      1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.8 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
   1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
   1. Liquid Penetrant Inspection: ASTM E 165.
   2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
   4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

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

3.2 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate.
   3. Snug-tighten Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened.
B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD QUALITY CONTROL
A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 05 1200
SECTION 05 4000
COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes the following:
   1. Exterior load-bearing wall framing.
   2. Interior load-bearing wall framing.

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

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product and accessory indicated.

1.4 INFORMATIONAL SUBMITTALS
A. Qualification data.
B. Welding certificates.
C. Product test reports.
D. Research/evaluation reports.

1.5 QUALITY ASSURANCE
A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating
   steel sheet complies with requirements.
B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code-
   -Sheet Steel."
C. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing
   identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and
   inspecting agency acceptable to authorities having jurisdiction.
D. AISI Specifications and Standards: Comply with AISI's "North American Specification for the
   Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel
   Framing - General Provisions."
   1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
   2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."
E. Comply with AISI's "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and
   Two Family Dwellings."

PART 2 - PRODUCTS

2.1 LOAD-BEARING WALL FRAMING
A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched,
   with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: As indicated on drawings.
B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated,
   unpunched, with straight flanges, and same minimum base-metal thickness as steel studs.
C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header
   beams, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
   2. Flange Width: 1-5/8 inches (41 mm).
2.2 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
   2. Flange Width: 1-5/8 inches (41 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and same minimum base-metal thickness as steel studs.

C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

2.3 FRAMING ACCESSORIES

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

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

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

D. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

E. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

F. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

2.4 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780.

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

C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

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

PART 3 - EXECUTION

3.1 PREPARATION

A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.
B. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.2 INSTALLATION, GENERAL
A. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
B. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
C. Install framing members in one-piece lengths.
D. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
E. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
F. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
H. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 LOAD-BEARING WALL INSTALLATION
A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
   1. Anchor Spacing: As shown on Drawings.
B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch (3 mm) between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
   1. Stud Spacing: As indicated.
C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
   1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced as indicated. Fasten at each stud intersection.

1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to 6 inches (150 mm) deep.

2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deflection tracks and anchor to building structure.

2. Install double deflection tracks and anchor outer track to building structure.

3. Connect vertical deflection clips to bypassing studs and anchor to primary building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Drawings. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

   a. Install solid blocking at centers indicated.

2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable curtain-wall-framing system.

3.5 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

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

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 4000
SECTION 05 5100
METAL STAIRS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Stairs with concrete treads.
B. Structural steel stair framing and supports.

1.02 SUBMITTALS
A. See Division One, for submittal procedures.
B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Include the design engineer's seal and signature on each sheet of shop drawings.
C. Delegated Design Data: As required by authorities having jurisdiction.
D. Welders' Certificates.
E. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is certified under AISC 201.

1.03 QUALITY ASSURANCE
A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.
B. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.
C. Fabricator Qualifications:
   1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
   2. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

PART 2 PRODUCTS

2.01 METAL STAIRS - GENERAL
A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
   1. Regulatory Requirements: Provide stairs and railings complying with the most stringent requirements of local, state, and federal regulations; where requirements of Contract Documents exceed those of regulations, comply with Contract Documents.
   2. Dimensions: As indicated on drawings.
   3. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
   4. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
   5. Separate dissimilar metals using paint or permanent tape.
B. Metal Jointing and Finish Quality Levels:
   1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
      a. Welded Joints: Continuously welded and ground smooth and flush.
b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
c. Exposed Edges and Corners: Eased to small uniform radius.
d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.

C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.02 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as described in paragraph 1.03, Quality Assurance referenced above, to design stairs and railings.

B. Structural Performance of Stairs: Metal Stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
   1. Uniform Load: 100 lbf/sq. ft.
   2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
   3. Uniform and concentrated loads need not be assumed to act concurrently.
   4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to load specified above.
   5. Limit deflection of treads, platforms, and framing members to L/240 or ¼ inch, whichever is less.

2.03 METAL STAIRS WITH CONCRETE Treads

A. Jointing and Finish Quality Level: Architectural, as defined above.

B. Risers: Closed.

C. Treads: Metal pan with field-installed concrete fill.
   1. Concrete Depth: 1-1/2 inches, minimum.
   2. Tread Pan Material: Steel sheet.
   3. Tread Pan Thickness: As required by design; 14 gage, 0.075 inch minimum.
   4. Pan Anchorage to Stringers: Continuously welded, from top or bottom.
   5. Concrete Reinforcement: None.
   6. Concrete Finish: For resilient floor covering.

D. Risers: Same material and thickness as tread pans.
   1. Nosing Depth: Not more than 1 inch overhang.
   2. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch wide.

E. Stringers: Rolled steel channels.
   1. Stringer Depth: 12 inches minimum, or as shown on drawings.
   2. End Closure: Sheet steel of same thickness as risers welded across ends.

F. Finish: Shop- or factory-prime painted.

2.04 HANDRAILS AND GUARDS

A. Wall-Mounted Rails: As specified in Section 05 5213.

2.05 MATERIALS

A. Steel Sections: ASTM A36/A36M.

B. Steel Plates: ASTM A6/A6M or ASTM A283/A283M.
C. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
   1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
   2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).
D. Concrete Fill: Portland cement Type I, 3000 psi 28 day strength, 2 to 3 inch slump.

2.06 ACCESSORIES
A. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1.
B. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
C. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.07 SHOP FINISHING
A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
B. Do not prime surfaces in direct contact with concrete or where field welding is required.
C. Prime Painting: Use specified shop- and touch-up primer.
   1. Preparation of Steel: In accordance with SSPC-SP 2, Hand Tool Cleaning.
   2. Number of Coats: One.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION
A. When field welding is required, clean and strip primed steel items to bare metal.
B. Grind, file and sand as required to remove all rough, un-even, sharp protrusions such as weld splatter or other inconsistencies as required to provide a smooth surface on all exposed components. Coordinate with Section 09 90 00, Painting and Coating.

3.03 INSTALLATION
A. Install components plumb and level, accurately fitted, free from distortion or defects.
B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.
C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.
E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
F. Obtain approval prior to site cutting or creating adjustments not scheduled.
G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.04 TOLERANCES
A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION
SECTION 05 5213
PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Wall mounted handrails.

1.02 RELATED REQUIREMENTS
A. Section 09 2116 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Division One for submittal procedures.
B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS
A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.
B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set.
C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set.
D. Allow for expansion and contraction of members and building movement without damage to connections or members.
E. Dimensions: See drawings for configurations and heights.
F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
   1. For anchorage to stud walls, provide backing plates, for bolting anchors.
G. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.02 STEEL RAILING SYSTEM
A. Steel Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
B. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
C. Straight Splice Connectors: Steel concealed spigots.
2.03 FABRICATION
   A. Accurately form components to suit specific project conditions and for proper connection to building structure.
   B. Fit and shop assemble components in largest practical sizes for delivery to site.
   C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
   D. Welded Joints:
      1. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
      2. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
   E. Fabrication Tolerances:
      1. Maximum Misalignment of Adjacent Members: 1/16 inch.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION
   A. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION
   A. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
   B. Anchor railings securely to structure.
   C. Conceal anchor bolts and screws whenever possible.

3.04 TOLERANCES
   A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
   B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION
SECTION 06 1000
ROUGH CARPENTRY

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Subflooring.
   B. Underlayment.
   C. Fire retardant treated wood materials.
   D. Communications and electrical room mounting boards.
   E. Concealed wood blocking, nailers, and supports.
   F. Miscellaneous wood nailers, furring, and grounds.

1.02 DELIVERY, STORAGE, AND HANDLING
   A. General: Cover wood products to protect against moisture. Support stacked products to
      prevent deformation and to allow air circulation.
   B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or
      installation.

PART 2 PRODUCTS
2.01 GENERAL REQUIREMENTS
   A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
      1. If no species is specified, provide any species graded by the agency specified; if no
         grading agency is specified, provide lumber graded by any grading agency meeting the
         specified requirements.
      2. Grading Agency: Any grading agency whose rules are approved by the Board of Review,
         American Lumber Standard Committee (www.alsc.org) and who provides grading service
         for the species and grade specified; provide lumber stamped with grade mark unless
         otherwise indicated.
   B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER
   A. Sizes: Nominal sizes as indicated on drawings or as required for proper completion of work,
      S4S.
   B. Moisture Content: S-dry or MC19.
   C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
      1. Lumber: S4S, No. 2 or Standard Grade.
      2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS
   A. Subflooring: Structural cementitious subfloor panels.
      1. Size: 48 inches wide nominal, by 96 inches long, nominal.
      2. Thickness: 3/4 inch, nominal.
      5. Surface Burning Characteristics: Flame spread index of 0; smoke-developed Index of 0;
         when tested in accordance with ASTM E84.
      6. Manufacturers:
b. Substitutions: See Division One.

B. Underlayment: APA Underlayment; plywood, Exposure 1, 1/4 inch thick. Fully sanded faces at resilient flooring.

C. Communications and Electrical Room Mounting Boards: PS 1 AC plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.04 ACCESSORIES

A. Fasteners and Anchors:
   2. Anchors: Purpose designated for size and spacing required by field conditions.

B. Subfloor Adhesives: Waterproof, air cure type, cartridge dispensed; adhesives designed for subfloor applications and complying with either ASTM C557 or ASTM D3498.

C. Building Paper: Water resistant Kraft paper.

2.05 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.

B. Fire Retardant Treatment:
   1. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Treat rough carpentry items as indicated.
      c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.
B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.02 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
3.03 INSTALLATION OF CONSTRUCTION PANELS
   A. Subflooring: Screw to framing; staples are not permitted.
   B. Underlayment: Secure to subflooring with nails and glue.
      1. Place building paper between floor underlayment and subflooring.
   C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
      1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
      2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
      3. Install adjacent boards without gaps.
      4. Size and Location: As indicated on drawings.

3.04 TOLERANCES
   A. Framing Members: 1/4 inch from true position, maximum.
   B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.05 CLEANING
   A. Waste Disposal: Comply with the requirements of Section 01 7419 - Construction Waste Management and Disposal.
      1. Comply with applicable regulations.
      2. Do not burn scrap on project site.
      3. Do not burn scraps that have been pressure treated.
      4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.
   B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
   C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION
SECTION 06 4100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Specially fabricated cabinet units.
   B. Solid Surface Countertops.
   C. Solid Surface Window Stools and Aprons.
   D. Cabinet Hardware.

1.02 SUBMITTALS
   A. See Division One for Submittal Procedures.
   B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
      1. Provide the information required by AWI/AWMAC/WI (AWS).

1.03 QUALITY ASSURANCE
   A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum three years of documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING
   A. Protect units from moisture damage.

1.05 FIELD CONDITIONS
   A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Approved manufactured modular casework meeting or exceeding the specified criteria may, at Contractor's option, be substituted in lieu of specially fabricated cabinet units. If modular casework is to be substituted, it must be submitted and approved as a substitution prior to bidding.
   B. Substitutions: See Division One.

2.02 CABINETS
   A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.

2.03 WOOD-BASED COMPONENTS
   A. Wood fabricated from old growth timber is not permitted.

2.04 LAMINATE MATERIALS
   A. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
   B. Provide specific types as follows:
      1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, colors as scheduled, finish as scheduled. See Finish Schedule on Drawings.
      2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, colors as scheduled, finish as scheduled. See Finish Schedule on Drawings.
3. Cabinet Liner: CLS, 0.020 inch nominal thickness, colors as scheduled, finish as scheduled. See Finish Schedule on Drawings.
4. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

C. See Finish Schedule on drawings for manufacturer, product, color, finish and locations.

2.05 COUNTERTOPS, WINDOW STOOLS AND APRONS
A. Solid surfacing sheet or plastic resin casting self-supporting over structural members for counter tops and over continuous substrate for window stools and aprons.
1. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
   a. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.

B. See Finish Schedule on drawings for manufacturer, product, color, finish and locations.

2.06 ACCESSORIES
A. Adhesive: Type recommended by AWI/AWMAC to suit application.
B. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
C. Fasteners: Size and type to suit application.
D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
E. Concealed Joint Fasteners: Threaded steel.
F. Grommets: Standard plastic or rubber grommets for cut-outs, in color to contrast with adjacent surface.

2.07 HARDWARE
A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards and coordinated self rests, satin chrome finish, for nominal 1 inch spacing adjustments.
C. Fixed Specialty Workstation and Countertop Brackets:
   1. Material: Steel.
   2. Finish: Manufacturer's standard, factory-applied powder coat.
   4. Manufacturers:
      a. Rakks/Rangine Corporation; EH Series Brackets: www.rakks.com/#sle
      b. Substitutions: See Division One.
D. Drawer and Door Pulls: "U" shaped wire pull, steel with satin finish, 4 inch centers.
E. Drawer Slides:
   1. Type: Standard extension.
   2. Static Load Capacity: As required by drawer size.
   4. Stops: Integral type.
F. Hinges: European style concealed self-closing type, steel with satin finish.

2.08 FABRICATION
A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
   1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
   2. Cap exposed plastic laminate finish edges with material of same finish and pattern.
E. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify adequacy of backing and support framing.
B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION
A. Install work in accordance with AWI/AWMAC/WI (AWS) requirements for grade indicated.
B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
C. Use fixture attachments in concealed locations for wall mounted components.
D. Use concealed joint fasteners to align and secure adjoining cabinet units and countertops.
E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
F. Secure cabinets to floor using appropriate angles and anchorages.
G. Install solid surface countertops, window stools and aprons in accordance with manufacturers instructions and consistant with drawings for profiles, thickness and details.

3.03 CLEANING
A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Foamed-in-place insulation.
      1. In exterior framed walls - at opening perimeters, as shown on drawings.

1.02 SUBMITTALS
   A. See Division One for Submittal Procedures.
   B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.
   C. Certificates: Certify that products of this section meet or exceed specified requirements.
   D. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.

1.03 FIELD CONDITIONS
   A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.
   B. Do not apply foam when temperature is within 5 degrees F of dew point.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Foamed-In-Place Insulation:
      2. Substitutions: See Division One.

2.02 MATERIALS
   A. Gap Air Infiltration Filler: Two-component, quick cure polyurethane foam.
      1. Acceptable Products: The Dow Chemical Company FROTH-PAK™ Foam Insulation two component, quick-cure polyurethane foam; NFPA 286 Approval for exposed use to the interior of the building without the need for a 15-min thermal barrier; ASTM E-84 Class A.

2.03 ACCESSORIES
   A. Primer: As required by insulation manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify work within construction spaces or crevices is complete prior to insulation application.
   B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat adhesion.

3.02 PREPARATION
   A. Mask and protect adjacent surfaces from over spray or dusting.
   B. Apply primer in accordance with manufacturer's instructions.

3.03 APPLICATION
   A. Apply insulation in accordance with manufacturer's instructions.
   B. Apply to a minimum cured thickness of 2 inch.
C. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.

D. Trim excess away for applied trim or remove as required for continuous sealant bead.

3.04 PROTECTION

A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION
SECTION 07 6200
SHEET METAL FLASHING AND TRIM

PART 1  GENERAL

1.01  SECTION INCLUDES
A. Fabricated sheet metal items, including flashings, counterflashings, and miscellaneous sheet metal items shown on drawings, not specified elsewhere.

1.02  SUBMITTALS
A. See Division One for Submittal Procedures.
B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.03  QUALITY ASSURANCE
A. Perform work in accordance with SMACNA (ASMM) requirements and standard details, except as otherwise indicated.
B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 3 years of documented experience.

1.04  DELIVERY, STORAGE, AND HANDLING
A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
B. Prevent contact with materials that could cause discoloration or staining.

PART 2  PRODUCTS

2.01  SHEET MATERIALS
A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239) inch thick base metal, shop pre-coated with PVDF coating.
   1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
   2. Color: As selected by Architect from manufacturer's full range of standard colors.

2.02  FABRICATION
A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
B. Fabricate cleats of same material as sheet, minimum 4 inches wide, interlocking with sheet.
C. Form pieces in longest possible lengths.
D. Hem exposed edges on underside 1/2 inch; miter and seam corners.
E. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

2.03  ACCESSORIES
A. Fasteners: Same material and finish as flashing metal.
B. Underlayment: ASTM D226/D226M, organic roofing felt, Type II (No. 30).
C. Primer: Manufacturer's recommended type.
D. Protective Backing Paint: Manufacturer's recommended type.
E. Sealants: Specified in Section 07 9200.
1. Type E1 for exposed sealants, color to match adjacent material.
2. Type E2 for concealed sealants.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify pipes, sleeves, and vents through roof are solidly set.

3.02 PREPARATION
A. Install starter and edge strips, and cleats before starting installation.
B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil. Manufacturer's standard back paint on pre-finished sheet metal items is acceptable in lieu of in-field back painting.

3.03 INSTALLATION
A. Conform to drawing details and/or SMACNA standards, whichever is most stringent.
B. Secure flashings in place using concealed cleats and fasteners, unless otherwise detailed.
C. Apply plastic cement compound between metal flashings and felt flashings.
D. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
E. Seal metal joints watertight with sealant specified in Section 07 9200.

END OF SECTION
SECTION 07 8400
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Firestopping systems.
B. Firestopping of joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.
C. Coordinate with work of Divisions 21 through 28.

1.02 SUBMITTALS
A. See Division One for Submittal Procedures.
B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
F. Installer Qualification: Submit qualification statements for installing mechanics.

1.03 QUALITY ASSURANCE
A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with ASTM E814.
1. Listing in the current-year classification or certification books of UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
C. Installer Qualifications: Company specializing in performing the work of this section and:
1. Trained by manufacturer.

1.04 FIELD CONDITIONS
A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Firestopping Manufacturers:
1. 3M Fire Protection Products: www.3m.com/firestop/#sle.
4. Substitutions: See Division One.
2.02 MATERIALS
A. Firestopping Materials: Any materials meeting requirements.
B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
C. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
E. Fire Ratings: Refer to drawings for required ratings.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS
A. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
   1. Movement: Provide systems that have been tested to show movement capability as indicated.
B. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
   1. Movement: Provide systems that have been tested to show movement capability as indicated.
   2. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.
C. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
   1. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.04 FIRESTOPPING SYSTEMS
A. Firestopping: Any material meeting requirements.
   1. Fire Ratings: Use system that is listed by UL (FRD) and tested in accordance with ASTM E814 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION
A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
B. Remove incompatible materials that could adversely affect bond.
C. Install damming materials to prevent liquid material from leakage.

3.03 INSTALLATION
A. Install materials in manner described in fire test report and in accordance with manufacturer’s instructions, completely closing openings.
B. Do not cover installed firestopping until inspected by Owner's Representative.
C. Install labeling required by code.

3.04 FIELD QUALITY CONTROL
   A. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.05 CLEANING
   A. Clean adjacent surfaces of firestopping materials.

3.06 PROTECTION
   A. Protect adjacent surfaces from damage by material installation.

END OF SECTION
SECTION 07 9200
JOINT SEALANTS

PART 1  GENERAL
1.01  SECTION INCLUDES
   A. Sealants, joint backing, and bond breakers.
   B. Joint backings and accessories.

1.02  ADMINISTRATIVE REQUIREMENTS
   A. Coordinate the work with other sections referencing this section.

1.03  SUBMITTALS
   A. See Division One for Submittal Procedures.
   B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be
      used, that includes the following.
      1. Physical characteristics, including movement capability, VOC content, hardness, cure
         time, and color availability.
      2. List of backing materials approved for use with the specific product.
      3. Substrates that product is known to satisfactorily adhere to and with which it is
         compatible.
      4. Substrates the product should not be used on.
   C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each
      product to be used, including physical characteristics, installation instructions, and
      recommended tools.
   D. Color Cards for Selection: Where sealant color is not specified, submit two (2) sets of
      manufacturer's color cards showing standard colors available for selection.

1.04  QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in
      this section with minimum ten years documented experience.
   B. Installer Qualifications: Company specializing in performing the work of this section and with
      at least three years of documented experience.

1.05  WARRANTY
   A. Correct defective work within a five year period after Date of Substantial Completion.
   B. Warranty: Include coverage for installed sealants and accessories that fail to achieve
      watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2  PRODUCTS
2.01  JOINT SEALANT APPLICATIONS
   A. Type E-1 - General Purpose Exterior Sealant: Polyurethane; ASTM C920, Grade NS, Class
      25, Uses M, G, and A; single or multi-component.
      1. Color: To be selected by Architect from manufacturer's standard range.
      2. Applications: Use for:
         a. Joints between metal frames and other materials.
         b. Other exterior joints for which no other sealant is indicated.
   B. Type E-2 - Exterior Metal Lap Joint Sealant: Butyl or plyisobutylene; non-drying, non-skinning,
      non-curing.
      1. Applications: Use for:
a. Concealed sealant bead in sheet metal work.

C. Type I-1 - General Purpose Interior Sealant: Acryclic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
   1. Color: To be selected by Architect from manufacturer's standard range.
   2. Applications: Use for:
      a. Interior wall and ceiling control joints.
      b. Joints between door and window frames and wall surfaces.
      c. Other interior joints for which no other type of sealant is indicated.

D. Type I-2 - Bathroom/Tile Sealant: Silicone; ASTM C920, USEse I, M, and A; single-component, mildew-resistant.
   1. Color: To be selected by Architect from manufacturer's standard range.
   2. Applications: Use for:
      a. Joints between plumbing fixtures and floor and wall surfaces.
      b. Joints between kitchen and bathroom countertops and wall surfaces.

E. Type I-3 - Acoustical Sealant: Butyl or acrylic sealant; ASTM C920, Grade NS, Class 12-1/2, Uses M and A; single component, solvent release curing, non-skinning.
   1. Applications: Use for concealed locations only:
      a. Sealant bead between 1) top stud runner and structure, and 2) bottom stud track and floor.
      b. Sealant between 1) top of gypsum wall board and structure, and 2) bottom of gypsum wall board and structure.
      c. Where noted on drawings.

2.02 ACCESSORIES
A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
   1. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbtent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that joints are ready to receive work.
B. Verify that backing materials are compatible with sealants.
C. Verify that backer rods are of the correct size.

3.02 PREPARATION
A. Remove loose materials and foreign matter that could impair adhesion of sealant.
B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
B. Perform installation in accordance with ASTM C1193.
C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
D. Install bond breaker backing tape where backer rod cannot be used.
E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.04 CLEANING

A. Clean adjacent surfaces of excess sealant and smears as a result of this work, before the sealant cures.
B. Repair joints that have shrunk, sagged, run, and/or that have thin spots or other defects.
C. Leave adjacent surfaces in as good or better condition than they were before sealant operations.

3.05 PROTECTION

A. Protect sealants until cured.

3.06 SCHEDULE

A. See Drawings for designated sealant joints.
B. Exterior joints for which no other sealant type is Indicated: Type E-1.
C. Soft joints between masonry and adjacent work: Type E-1.
D. Lap joints in exterior sheet metal work: Type E-2.
E. Joints between exterior metal frames and adjacent work: Type E-1.
F. Under exterior and/or garage - door thresholds: Type E-1.
G. Interior joints for which no other sealant is indicated: Type I-1.
H. Joints between plumbing fixtures and walls/floors, and between countertops and walls: Type I-2.
I. In STC-rated walls, between metal stud track/runner and adjacent construction and between outlet boxes and gypsum board: Type I-3.

END OF SECTION
SECTION 08 1213
HOLLOW METAL FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Non-fire-rated hollow metal frames for non-hollow metal doors.
B. Fire-rated hollow metal frames for non-hollow metal doors.

1.02 SUBMITTALS
A. See Division One for Submittal Procedures.
B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.
C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.
D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
F. Manufacturer's Qualification Statement.

1.03 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING
A. Store in accordance with applicable requirements and in compliance with standards and/or custom guidelines as indicated.
B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Hollow Metal Frames with Integral Casings:
   4. Substitutions: See Division One.

2.02 PERFORMANCE REQUIREMENTS
A. Refer to Door and Frame Schedule on the drawings for frame sizes, fire ratings, sound ratings, finishing, and other variations, if any.
B. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
C. Accessibility: Comply with ICC A117.1 and ADA Standards.
D. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior frame that is also indicated as being sound-rated must comply with the
requirements specified for exterior frames and for sound-rated frames; where two requirements conflict, comply with the most stringent.

E. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115, NAAMM HMMA 830, NAAMM HMMA 831 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

F. Provide mortar guard/dust boxes for hardware cut-outs in all frames.

G. Frames Wider than 48 Inch: Reinforce with steel channel fitted tightly into head of frame, flush with top.

2.03 HOLLOW METAL DOOR FRAMES WITH INTEGRAL CASINGS

A. Frame Finish: Factory primed and field finished.

B. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 3 - Extra Heavy-duty.
      b. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.

C. Interior Door Frames, Fire-Rated: Full profile/continuously welded type.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 3 - Extra Heavy-duty.
      b. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
   2. Fire Rating: As indicated on drawings, tested in accordance with UL 10C or NFPA 252 ("positive pressure fire tests").
   3. Provide units listed and labeled by UL (DIR).
      a. Attach fire rating label to each fire rated unit.

2.04 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.05 ACCESSORIES

A. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.

B. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

A. Install frames in accordance with manufacturer's instructions and related requirements of specified frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Install door hardware as specified in Section 08 7100.

E. Coordinate installation of electrical connections to electrical hardware items.
3.03 TOLERANCES
   
   A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
   
   B. Maximum Diagonal Distortion: 1/16 inch measured with straight edges, crossed corner to corner.

3.04 SCHEDULE
   
   A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION
SECTION 08 1416
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Flush wood doors; flush configuration; fire-rated and non-rated.

1.02 SUBMITTALS
A. See Division One for Submittal Procedures.
B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
   1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
D. Samples: Submit two samples of door veneer, 10 x 10 inch in size illustrating wood grain, stain color, and sheen.
E. Manufacturer's Installation Instructions: Indicate special installation instructions.
F. Specimen warranty.
G. Warranty, executed in Owner's name at completion of work.

1.03 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING
A. Package, deliver and store doors in accordance with specified quality standard.
B. Accept doors on site in manufacturer's packaging. Inspect for damage.
C. Protect doors with resilient packaging. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.05 WARRANTY
A. Interior Doors: Provide manufacturer's warranty for the life of the installation.
B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Wood Veneer Faced Doors:
   4. Substitutions: See Division One.

2.02 DOORS
A. Doors: Refer to drawings for locations and additional requirements.
B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.
   2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C -
      Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI)
      labeled without any visible seals when door is open (conceal required intumescents in
      door edge).

2.03 DOOR FACINGS
A. Factory finished. Color shown in finish schedule on drawings, meeting or exceeding WDMA
   TR-6. WDMA, Premium, with "A" grade veneer, rift cut and balance matched.
   1. Vertical Edges: Same species as face veneer.
B. Facing Adhesive: Type I - waterproof.

2.04 DOOR CONSTRUCTION
A. Fabricate doors in accordance with door quality standard specified.
B. Factory machine doors for hardware other than surface-mounted hardware, in accordance with
   hardware requirements and dimensions.
C. Factory fit doors for frame opening dimensions identified on shop drawings, with edge
   clearances in accordance with specified quality standard.
D. Provide edge clearances in accordance with the quality standard specified.

2.05 ACCESSORIES
A. Hollow Metal Door Frames: As specified in Section 08 1213.
B. Door Hardware: As specified in Section 08 7100.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify existing conditions before starting work.
B. Verify that opening sizes and tolerances are acceptable.
C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or
   alignment.

3.02 INSTALLATION
A. Install doors in accordance with manufacturer's instructions and specified quality standard.
   1. Install fire-rated doors in accordance with NFPA 80 requirements.
B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
C. Use machine tools to cut or drill for hardware.
D. Coordinate installation of doors with installation of frames and hardware.

3.03 TOLERANCES
A. Comply with specified quality standard for fit and clearance tolerances.
B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING
A. Adjust doors for smooth and balanced door movement.
B. Adjust closers for full closure.
3.05 SCHEDULE - SEE DRAWINGS

END OF SECTION
SECTION 08 3100
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Wall and ceiling mounted access units.
B. Coordinate with work of Divisions 21 through 28.

1.02 SUBMITTALS
A. See Division One for Submittal Procedures.
B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
D. Manufacturer's Installation Instructions: Indicate installation requirements and rough-in dimensions.
E. Project Record Documents: Record actual locations of each access unit.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES
A. Wall-Mounted Units, unless otherwise indicated on Drawings:
   1. Panel Material: Steel.
   2. Size: 12 inch by 12 inches, unless otherwise indicated.
   3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
   5. Finish: Prime coat with manufacturer's gray primer; field finish to match adjacent surface. Coordinate with Section 09 9000.
B. Wall-Mounted Units in Wet Areas:
   2. Size: 12 inch by 12 inches, unless otherwise indicated.
   3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
   5. Finish: Prime coat with manufacturer's gray primer; field finish to match adjacent surface. Coordinate with Section 09 9000.
C. Fire-Rated Wall-Mounted Units:
   1. Wall Fire-Rating: As indicated on drawings.
   4. Door/Panel: Uninsulated single-surface panel, with tool-operated spring or cam lock and no handle.
   5. Finish: Prime coat with manufacturer's gray primer; field finish to match adjacent surface. Coordinate with Section 09 9000.
D. Ceiling-Mounted Units, :
   1. Panel Material: Steel.
   2. Size - Other Ceilings: 12 inch by 12 inch.
   3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
4. Finish: Prime coat with manufacturer's gray primer; field finish to match adjacent surface. Coordinate with Section 09 9000.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that rough openings are correctly sized and located.

3.02 INSTALLATION
A. Install units in accordance with manufacturer's instructions.
B. Install frames plumb and level in openings, and secure units rigidly in place.
C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION
SECTION 08 3616
HIGH PERFORMANCE BARN (SLIDING) DOOR

PART 1 - GENERAL

1.01 SUMMARY
A. Barn (Sliding) Doors - flush wood, aluminum frames and related hardware.

1.02 RELATED SECTION
A. Section 08 1416 - Flush Wood Doors.

1.03 SUBMITTALS
A. See Division One for Submittal Procedures.
B. Product Data: Submit manufacturer’s product data, including installation instructions.
C. Shop Drawings: Submit manufacturer’s shop drawings, including plans, elevations, sections, and details, indicating dimensions, tolerances, materials, components, hardware, finish, options, and accessories. Shop Drawings to show required blocking by others.
D. Warranty Documentation: Submit manufacturer’s standard warranty.

1.04 QUALITY ASSURANCE
A. Product Options: Drawings indicate size, profiles, and dimensional requirements of interior aluminum frames and doors.
B. Source: Integrated assembly. Obtain sliding aluminum framed doors, Door leaves and door hardware and seal systems from single source integrated assembly manufacturer.

1.05 PERFORMANCE
A. Aluminum perimeter frames with integral acoustic seals
B. Soft self-closing mechanism integrated with top track at both sides of door
C. Concealed door guide

1.06 DELIVERY: STORAGE AND PROTECTION
A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
B. Notify manufacturer immediately of any shipping damage.
C. Storage and Handling Requirements:
   1. Store and handle materials in accordance with manufacturer’s instructions.
   2. Keep materials in manufacturer’s original, unopened containers and packaging until installation.
   3. Store materials in clean, dry area indoors.
   4. Protect materials and finish during storage, handling, and installation to prevent damage.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Basis of Design manufacturer is AD SYSTEMS; http://specADsystems.com.
B. Other manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product.
C. Substitution Procedures: See Division One.
2.02 INTERIOR SLIDING ALUMINUM-FRAMED DOORS AND PARTITIONS

A. Interior Aluminum-Framed Integrated Assembly High Performance Top-Hung Barn (Sliding) Doors with no visible bottom track by AD Systems.

B. Specified Wall Thickness: See floor plans.

C. Frame Profiles: Extruded aluminum frame “wrap” frame with integral vertical jamb (stile pocket).
   1. Finish: Custom Painted Hardcoat (Kynar) Finish: See finish schedule and/or legend in drawings.

D. Door Leafs. All Doors to be factory machined for hardware including pilot and function holes.

E. Integrated Assembly Door Components:
   1. Single Top Track: High Performance barn door track
   2. Valances: Extruded aluminum with integral end caps; Standard square valance.
   3. Top Rollers: Tandem nylon roller sized to match door weight.
   5. Soft-Closer: Soft and self-closing damper mechanism at both sides of door leaf.
   7. Mortise Latch and Lock: Privacy-function thumb-turn with indicator and lever; ADA-compliant.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine wall openings to receive sliding doors for plumb, level, and square.

B. Verify dimensions of wall openings.

C. Examine surfaces to receive top and bottom guide. Confirm wood blocking is in place per manufacturer requirements.

D. Notify Owner’s Representative of conditions that would adversely affect installation or subsequent use of sliding doors.

E. Do not begin installation until unacceptable conditions are corrected.

3.02 INSTALLATION

A. Install sliding doors in accordance with manufacturer’s instructions at locations indicated on the Drawings.

B. Install sliding doors plumb, level, square, and in proper alignment.

C. Install sliding doors to close against walls without gaps

D. Install sliding doors to open and close smoothly.

E. Anchor sliding doors securely in place to supports.

3.03 ADJUSTING

A. Adjust sliding doors for proper operation in accordance with manufacturer’s instructions.

B. Adjust sliding doors to operate smoothly without binding.

C. Repair minor damages to finish in accordance with manufacturer’s instructions and as approved by Architect.
3.04 CLEANING
   A. Clean sliding doors promptly after installation in accordance with manufacturer’s instructions.
   B. Do not use harsh cleaning materials or methods that could damage materials or finish.

3.05 PROTECTION
   A. Protect installed sliding doors from damage during construction.

   END OF SECTION
SECTION 08 5113
ALUMINUM WINDOWS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Extruded aluminum windows with operating sash.
   B. Factory glazing.
   C. Operating hardware.
   D. Insect screens.

1.02 SUBMITTALS
   A. See Division One for Submittal Procedures.
   B. Product Data: Provide component dimensions, information on glass and glazing, internal drainage details, and descriptions of hardware and accessories.
   C. Shop Drawings: Indicate opening dimensions, elevations of different types, framed opening tolerances, method for achieving air and vapor barrier seal to adjacent construction, anchorage locations, and installation requirements.
   D. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.
   E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
   B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING
   A. Comply with requirements of AAMA CW-10.
   B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.05 FIELD CONDITIONS
   A. Do not install sealants when ambient temperature is less than 40 degrees F.
   B. Maintain this minimum temperature during and 24 hours after installation of sealants.

1.06 WARRANTY
   A. Correct defective Work within a five year period after Date of Substantial Completion.
   B. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
   C. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.
PART 2 PRODUCTS

2.01 MANUFACTURERS
B. Other Acceptable - Aluminum Windows Manufacturers:
   2. TRACO: www.traco.com/#sle.
   3. Substitutions: See Division One.

2.02 ALUMINUM WINDOWS
A. Aluminum Windows: Extruded aluminum frame and sash, factory fabricated, factory finished, with operating hardware, related flashings, and anchorage and attachment devices.
   1. Performance Class: CW.
   2. Performance Grade: PG40.
   4. Operable Units: Double weatherstripped.
   5. Provide units factory glazed.
   6. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for operating hardware and imposed loads.
   7. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
   8. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
   9. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
B. Horizontal Sliding Type:
   2. Provide screens.
   3. Glazing: Double; clear; low-e.
   4. Exterior and Interior Finish: Baked-on powder coat meeting ANSA/AAMA 2604 requirements.
      a. Color: As selected by Architect from manufacturer's full range.

2.03 COMPONENTS
A. Insect Screens: Extruded aluminum frame with mitered and reinforced corners; screen mesh taut and secure to frame; secured to window with adjustable hardware allowing screen removal without use of tools.
   1. Screen Mesh: Vinyl-coated fiberglass, window manufacturer's standard mesh.
   2. Frame Finish: Same as frame and sash.
B. Operable Sash Weatherstripping: Wool pile; permanently resilient, profiled to achieve effective weather seal.
C. Fasteners: Stainless steel.
D. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.
PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that wall openings and adjoining air and vapor seal materials are ready to receive aluminum windows.

3.02 INSTALLATION
A. Install windows in accordance with manufacturer's instructions.
B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.
D. Install sill and sill end angles.
E. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
F. Install perimeter sealant in accordance with requirements specified in Section 07 9200.

3.03 ADJUSTING
A. Adjust hardware for smooth operation and secure weathertight closure.

3.04 CLEANING
A. Remove protective material from factory finished aluminum surfaces.
B. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.
C. Remove excess glazing sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.

3.05 SCHEDULE
A. See Drawings for Window Schedule.

END OF SECTION
SECTION 08 7100
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Hardware for wood doors.
   B. Hardware for fire-rated doors.
   C. Hardware for pocket doors.
   D. Hardware for existing doors.
   E. Electrically operated and controlled hardware.
   F. Thresholds.
   G. Weatherstripping and gasketing.

1.02 ADMINISTRATIVE REQUIREMENTS
   A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.
   B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
   C. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
   D. Convey Owner's keying requirements to manufacturers.

1.03 SUBMITTALS
   A. See Division One for Submittal Procedures.
   B. Product Data: Manufacturer’s catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
   C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
      1. Provide complete description for each door listed.
      2. Provide manufacturer's and product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
      3. Include account of abbreviations and symbols used in schedule.
   D. Manufacturer’s Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
   E. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
   F. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
   G. Keys: Deliver with identifying tags to Owner by security shipment direct from hardware supplier.
   H. Maintenance Materials and Tools: Furnish the following for Owner’s use in maintenance of project.
1. Tools: One set of each special wrench or tool applicable for each different or special hardware component, whether supplied by hardware component manufacturer or not.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of experience.

B. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of experience.

C. Supplier Qualifications: Company specializing in supplying commercial door hardware with at least three years of experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide door hardware products that comply with the following requirements:
   1. Applicable provisions of federal, state, and local codes.
   4. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
   5. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR) as suitable for application indicated.
   6. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.

C. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.

D. Finishes: Provide door hardware of the same finish unless otherwise indicated.
   1. Finish: Satin chrome plated over nickel on brass or bronze, 626 (approx. US26D).

E. Provide non-removable pins (NRP) when hinges are exposed to the outside of a room with locking hardware or to the exterior of exterior doors.

2.02 KEYING

A. Door Locks: Supply Best 7-Pin cores to Owner with 2 key blanks per core. Owner will do their own combining. Furnish construction cores until Owner installs permanent cores.

2.03 MANUFACTURERS

A. Basis of Design manufacturers as listed below. Substitutions - See Division One.

B. Hinges:

C. Leversets:
D. Magnetic Card Reader:
   1. Card reader and final connections furnished by Owner. Contractor shall provide all rough-in, including conduits, boxes and wiring. Provide coordination of all hardware and wiring to ensure compatibility with Owner's card access system. See electrical drawings for door control riser diagrams, electrical details, and card access details.

E. Door Position Switch:

F. Strikes:
      a. Standard Strike: 8KS2 with 8KS1 Strike Box.
      b. Power Supply: Von Duprin PS914.

G. Closers:

H. Flushbolts:

I. Wall and Floor Stops/ Holders:

J. Gasketing and Thresholds:

K. Pocket Door:

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.
   B. Verify that electric power is available to power operated devices and of correct characteristics.

3.02 INSTALLATION
   A. Install hardware in accordance with manufacturer's instructions and applicable codes.
   B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.
   C. Use templates provided by hardware item manufacturer.
   D. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
      1. For Wood Doors: Install in compliance with DHI WDHS.3 recommendations.
   E. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.
3.03 ADJUSTING
   A. Adjust hardware for smooth operation.
   B. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.04 PROTECTION
   A. Protect finished work.
   B. Do not permit adjacent work to damage hardware or finish.

3.05 SCHEDULE
   A. Immediately following this section.

END OF SECTION
## SECTION 08 7100.01

### DOOR HARDWARE SCHEDULE

#### Hardware Group 1: Single Side-Swinging Doors, 1-hour fire-rated: 1000A, 1000B

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Item Description</th>
<th>Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>BB1168 4-1/2x4-1/2 NRP Butts</td>
<td>Hager</td>
</tr>
<tr>
<td>1</td>
<td>4040XP Surface-Mount Parallel Arm (180-degree opening)</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>9K-3-7-D-14-D-STK-626 (ANSI F86) Leverset</td>
<td>Best</td>
</tr>
<tr>
<td>1</td>
<td>342D x US32D Latch Protection Plate w/ Escutcheon Cut Out</td>
<td>Hager</td>
</tr>
<tr>
<td>1</td>
<td>7400-628 Electric Strike</td>
<td>Adams-Rite</td>
</tr>
<tr>
<td>1</td>
<td>423S Threshold</td>
<td>Hager</td>
</tr>
<tr>
<td>1</td>
<td>881S Weatherstrip</td>
<td>Hager</td>
</tr>
<tr>
<td>1</td>
<td>801S Door Bottom Sweep</td>
<td>Hager</td>
</tr>
<tr>
<td>1</td>
<td>Owner Provided and Installed Card Reader</td>
<td>Owner Provided and Installed</td>
</tr>
<tr>
<td>1</td>
<td>PS914-BBK Power Supply</td>
<td>Von Duprin</td>
</tr>
<tr>
<td>1</td>
<td>7764 - Concealed, flush mount</td>
<td>Schlage</td>
</tr>
<tr>
<td>1</td>
<td>234W x US26D Wall Stop</td>
<td>Hager</td>
</tr>
</tbody>
</table>

#### Hardware Group 2: Single Side-Swinging Doors, 1-hour fire-rated: 1001A, 1002A

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Item Description</th>
<th>Supplier</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>BB1168 4-1/2x4-1/2 NRP Butts</td>
<td>Hager</td>
</tr>
<tr>
<td>1</td>
<td>4040XP Closer</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>9K-3-7-D-14-D-STK-626-TL (ANSI F86) Leverset (Tactile)</td>
<td>Best</td>
</tr>
<tr>
<td>1</td>
<td>234W x US26D Wall Stop</td>
<td>Hager</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Quantity</th>
<th>Item Description</th>
<th>Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>BB1168 4-1/2x4-1/2 NRP Butts</td>
<td>Hager</td>
</tr>
<tr>
<td>1</td>
<td>9K-3-7-L-14-D-STK-626 (ANSI F76) Leverset</td>
<td>Best</td>
</tr>
<tr>
<td>1</td>
<td>234W x US26D Wall Stop</td>
<td>Hager</td>
</tr>
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</table>

#### Hardware Group 4: Single Sliding Barn Door: 1005


<table>
<thead>
<tr>
<th>Quantity</th>
<th>Item Description</th>
<th>Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2060 Pocket Door Kit</td>
<td>Johnson Hardware</td>
</tr>
<tr>
<td>1</td>
<td>330D Pocket Door Latch</td>
<td>Hager</td>
</tr>
</tbody>
</table>

#### Hardware Group 6: Single Side-Swinging Doors: 2005

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Item Description</th>
<th>Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>BB1168 4-1/2x4-1/2 NRP Butts</td>
<td>Hager</td>
</tr>
<tr>
<td>1</td>
<td>9K-3-7-D-14-D-STK-626 (ANSI F86) Leverset</td>
<td>Best</td>
</tr>
<tr>
<td>1</td>
<td>234W x US26D Wall Stop</td>
<td>Hager</td>
</tr>
</tbody>
</table>

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See Specification Section 08 3616

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1501 Creekwood Parkway - 1501 Creekwood Parkway - Ambulance Base
### Hardware Group 7: Single Side-Swinging Doors: 2003

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Item Description</th>
<th>Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 ea.</td>
<td>BB1168 4-1/2x4-1/2 NRP</td>
<td>Butts Hager</td>
</tr>
<tr>
<td>1 ea.</td>
<td>342D x US32D</td>
<td>Latch Protection Plate w/ Escutcheon Cut Out Hager</td>
</tr>
<tr>
<td>1 ea.</td>
<td>9K-3-7-D-14-D-STK-626-TL (ANSI F86)</td>
<td>Leverset (Tactile) Best</td>
</tr>
<tr>
<td>1 ea.</td>
<td>234W x US26D</td>
<td>Wall Stop Hager</td>
</tr>
<tr>
<td>1 ea.</td>
<td>Owner Provided and Installed</td>
<td>Card Reader Owner Provided and Installed</td>
</tr>
<tr>
<td>1 ea.</td>
<td>7764 - Concealed, flush mount</td>
<td>Power Supply Von Duprin</td>
</tr>
<tr>
<td>1 ea.</td>
<td>PS914-BBK</td>
<td>Door Position Switch Schlage</td>
</tr>
</tbody>
</table>

### Hardware Group 8: Double Side-Swinging Doors: 2006

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Item Description</th>
<th>Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 ea.leaf, 6 total</td>
<td>BB1168 4-1/2x4-1/2 NRP</td>
<td>Butts Hager</td>
</tr>
<tr>
<td>1 ea.</td>
<td>9K-3-7-D-14-D-STK-626 (ANSI F86)</td>
<td>Leverset Best</td>
</tr>
<tr>
<td>1 ea.</td>
<td>342D x US32D</td>
<td>Latch Protection Plate w/ Escutcheon Cut Out Hager</td>
</tr>
<tr>
<td>1 ea.</td>
<td>7400-628</td>
<td>Electric Strike Adams-Rite</td>
</tr>
<tr>
<td>1 ea.</td>
<td>WDC7400</td>
<td>Wood Door Strike Cover Adams-Rite</td>
</tr>
<tr>
<td>1 ea.</td>
<td>296W x US32D</td>
<td>Automatic Flush Bolts (Top and Bottom, on inactive (south) leaf) Hager</td>
</tr>
<tr>
<td>1 ea.</td>
<td>280X x US26D</td>
<td>Dust Proof Strike Hager</td>
</tr>
<tr>
<td>1 ea.</td>
<td>Owner Provided and Installed</td>
<td>Card Reader Owner Provided and Installed</td>
</tr>
<tr>
<td>1 ea.</td>
<td>PS914-BBK</td>
<td>Power Supply Von Duprin</td>
</tr>
<tr>
<td>1 ea.</td>
<td>4612</td>
<td>Power Transfer Device Adams-Rite</td>
</tr>
<tr>
<td>1 ea.</td>
<td>7764 - Concealed, flush mount</td>
<td>Door Position Switch Schlage</td>
</tr>
</tbody>
</table>

### Hardware Group 9: Existing Aluminum Side-Swinging Door: EX1000A

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butts</td>
<td>Hager</td>
</tr>
<tr>
<td>Closer</td>
<td></td>
</tr>
<tr>
<td>Push/Pull Bar</td>
<td></td>
</tr>
<tr>
<td>Electric Strike</td>
<td>Adams-Rite</td>
</tr>
<tr>
<td>Card Reader</td>
<td>Owner Provided and Installed</td>
</tr>
<tr>
<td>Power Supply</td>
<td>Von Duprin</td>
</tr>
<tr>
<td>Power Transfer Device</td>
<td>Adams-Rite</td>
</tr>
<tr>
<td>Door Position Switch</td>
<td>Schlage</td>
</tr>
</tbody>
</table>

### Hardware Group 10: Existing Aluminum Side-Swinging Door: EX1000B

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butts</td>
<td>Hager</td>
</tr>
<tr>
<td>Closer</td>
<td></td>
</tr>
<tr>
<td>Push/Pull Bar</td>
<td></td>
</tr>
<tr>
<td>Remove hardware; cap attachments holes.</td>
<td></td>
</tr>
<tr>
<td>Salvage push/pull and return to Owner.</td>
<td></td>
</tr>
</tbody>
</table>
SECTION 08 8700
ARCHITECTURAL WINDOW FILMS

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Privacy glazing film applied to existing glazing assemblies.
B. Glazing assemblies to receive film are indicated on drawings.

1.02 SUBMITTALS
A. See Division One for Submittal Procedures.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Cleaning methods, including precautions against harmful cleaning materials and methods.
C. Samples: For each film product to be used, minimum size 4 inches by 4 inches, representing actual product, color, and patterns.

1.03 QUALITY ASSURANCE
A. Manufacturer Qualifications: Glazing film manufacturer with minimum 5 years successful experience.
B. Installer Qualifications: Certified by glazing film manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING
A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of authorities having jurisdiction.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. Basis of Design: 3M Window Film; Fasara Glass Finishes- Chamonix (SH2EMCH): www.solutions.3m.com/#sle.
B. Substitutions: See Division One.

2.02 MATERIALS
A. Glazing Film: Transparent polyester film for permanent bonding to glass.
   1. Thickness: 120 microns, minimum.
   2. Film Type: Polyester.
   3. Adhesive Type: Pressure sensitive.
   4. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84 (Class A).
   7. Shading Coefficient: 0.67.
B. Accessory Materials: As recommended or required by film manufacturer.
C. Glass Cleaner: As recommended by glazing film manufacturer.
PART 3 EXECUTION

3.01 EXAMINATION
   A. Examine glass and frames. Verify that existing conditions are adequate for proper application
      and performance of film.
   B. Verify glass is not cracked, chipped, broken, or damaged.
   C. Verify that frames are securely anchored and free of defects.
   D. If substrate preparation is the responsibility of another installer, notify Owner's Representative
      of unsatisfactory preparation before proceeding.

3.02 PREPARATION
   A. Clean glass of dust, dirt, paint, oil, grease, mildew, mold, and other contaminants that would
      inhibit adhesion.
   B. Immediately prior to applying film, thoroughly wash glass with neutral cleaning solution.
   C. Protect adjacent surfaces.
   D. Do not begin installation until substrates have been properly prepared.

3.03 INSTALLATION
   A. Do not apply glazing film when surface temperature is less that 40 degrees F or if precipitation
      is imminent.
   B. Install in accordance with manufacturer's instructions, without air bubbles, wrinkles, streaks,
      bands, thin spots, pinholes, or gaps, as required to achieve specified performance.
   C. Accurately cut film with straight edges to required sizes allowing 1/16 inch to 1/8 inch gap at
      perimeter of glazed panel unless otherwise required by anchorage method.
   D. Seams: Seam film only as required to accommodate material sizes; form seams vertically
      without overlaps and gaps; do not install with horizontal seams.
   E. Clean glass and anchoring accessories following installation. Remove excess sealants and
      other glazing materials from adjacent finished surfaces.
   F. Remove labels and protective covers.

3.04 PROTECTION
   A. Protect installed products until completion of project.
   B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION
SECTION 09 0561
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
   1. Resilient tile and sheet.
   2. Fluid-Applied Flooring.
B. Preparation of existing concrete floor slabs for installation of floor coverings.
C. Testing of concrete floor slabs for moisture and alkalinity (pH).
D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
   1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency’s report and is due to a condition not under Contractor’s control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
E. Patching compound.
F. Remedial floor coatings.
G. Preparation of new wood-based floors and subfloors for installation of new floor coverings.

1.02 UNIT PRICES

A. Base Bid Quantities indicated in the Bid Form and below are for bidding and contract purposes only. Quantities and measurements of actual Work and the Unit Prices bid for each category of work will determine the amount of adjustment of payment, up or down.
B. See Bid Form and below for Unit Price requirements and Base Bid quantities.
C. Unit Price for Alternate Flooring Adhesive: Do not include the cost of the alternate adhesive in the base bid; state on the bid form the unit price per square foot for using the alternate adhesive, in the event such remediation is required.
   1. Base the unit price on a total quantity calculated by assuming that only 50 percent of the flooring will require the alternate adhesive.
D. Unit Price for Remedial Floor Coating: Do not include the cost of the floor coating in the base bid; state on the bid form the unit price per square foot for the floor coating, installed, in the event such remediation is required.
   1. Base the unit price on a total quantity calculated by assuming that only 50 percent of the flooring will require the alternate adhesive.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.04 SUBMITTALS

A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.
B. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
1. Manufacturer's qualification statement.
2. Manufacturer's statement of compatibility with types of flooring applied over remedial product.
3. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
4. Manufacturer's installation instructions.
5. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.

C. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. Moisture and alkalinity (pH) test reports.
   5. Recommendations for remediation of unsatisfactory surfaces.
   6. Submit report directly to Owner's Representative with copy provided to Architect.
   7. Submit report not more than two business days after conclusion of testing.

D. Adhesive Bond and Compatibility Test Report.

1.05 QUALITY ASSURANCE

A. Moisture and alkalinity (pH) testing will be performed by an independent testing agency employed and paid by Owner.

B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
   1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.

C. Contractor's Responsibility Relating to Independent Agency Testing:
   1. Provide access for and cooperate with testing agency.
   2. Confirm date of start of testing at least 10 days prior to actual start.
   3. Allow at least 4 business days on site for testing agency activities.
   4. Achieve and maintain specified ambient conditions.
   5. Notify Owner when specified ambient conditions have been achieved and when testing will start.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.

B. Deliver materials in manufacturer's packaging; include installation instructions.

C. Keep materials from freezing.

1.07 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.
PART 2 PRODUCTS

2.01 MATERIALS

A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
   1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
   2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.

B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.

C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
   1. Thickness: 1/8 inch, maximum.
   2. Use products and remediation methods recommended by testing agency and approved by flooring and flooring adhesive manufacturers.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Coordinate substrate preparation to include remedial measures proposed by the testing agency and flooring preparation/installation as specified in other Sections.

B. Perform following operations in the order indicated:
   1. Preliminary cleaning.
   2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
   3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   5. Specified remediation, if required.
   6. Patching, smoothing, and leveling, as required.
   7. Other preparation specified.
   9. Protection.

C. Remediations:
   1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
   2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 PRELIMINARY CLEANING
   A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
   B. Do not use solvents or other chemicals for cleaning.

3.03 MOISTURE VAPOR EMISSION TESTING
   A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
   B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
   C. Test in accordance with ASTM F1869 and as follows.
   D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
   E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
   F. Report: Report the information required by the test method.

3.04 INTERNAL RELATIVE HUMIDITY TESTING
   A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
   B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
   C. Test in accordance with ASTM F2170 Procedure A and as follows.
   D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
   E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
   F. Report: Report the information required by the test method.

3.05 ALKALINITY TESTING
   A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
   B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
      1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
      2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds,
then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.

3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.

C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.06 PREPARATION
   A. See individual floor covering section(s) for additional requirements.
   B. Comply with mutual recommendations of testing agency, flooring installer, floor covering manufacturer and adhesive manufacturer.
   C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
   D. Do not fill expansion joints, isolation joints, or other moving joints.

3.07 ADHESIVE BOND AND COMPATIBILITY TESTING
   A. Comply with requirements and recommendations of floor covering manufacturer.

3.08 APPLICATION OF REMEDIAL FLOOR COATING
   A. Comply with requirements and recommendations of coating manufacturer.

3.09 PROTECTION
   A. Cover prepared floors with building paper or other durable covering.

END OF SECTION
SECTION 09 2116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Metal stud wall framing.
   B. Metal channel ceiling framing.
   C. Acoustic insulation.
   D. Cementitious backing board.
   E. Gypsum wallboard.
   F. Joint treatment and accessories.
   G. Textured finish system.

1.02 SUBMITTALS
   A. See Division One for Submittal Procedures.
   B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
   C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.03 QUALITY ASSURANCE
   A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 3 years of experience.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES
   A. Provide completed assemblies complying with ASTM C840 and GA-216.
      1. See PART 3 for finishing requirements.
   B. Fire Rated Assemblies: Provide completed assemblies complying with applicable code. Locations and ratings as shown on drawings. Comply with the following assembly numbers where applicable.
      1. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.
      2. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.
      3. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS
   A. Manufacturers - Metal Framing, Connectors, and Accessories:
      4. Substitutions: See Division One.
   B. Structural Steel Framing for Application of Gypsum Board: As specified in Section 05 4000.
C. Non-structural Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/360 at 5 psf. Use 20 gage minimum.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C-shaped.

D. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
   2. Products:
      a. Same manufacturer as other framing materials.

E. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
   3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
   4. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.
      a. Products:
         1) FireTrak Corporation; Posi Klip.
         2) Metal-Lite, Inc; The System.
         3) Substitutions: See Division One.

F. Non-structural Framing Accessories:
   1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
   2. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   4. Substitutions: See Division One.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   4. Thickness:
   5. Mold Resistant Paper Faced Products:
a. Georgia-Pacific Gypsum; ToughRock Mold-Guard.
b. National Gypsum Company; Gold Bond XP Gypsum Board.
c. USG Corporation; Sheetrock Brand Mold Tough Gypsum Board.

C. Backing Board For Wet Areas:
1. Application: Surfaces in wet areas including tub and shower surrounds.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
   a. Thickness: 1/2 inch.

D. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, tongue-and-groove long edges, ends square cut.
1. Glass Mat Faced Type: Glass mat shaftliner gypsum panel or glass mat coreboard gypsum panel as defined in ASTM C1658/C1658M.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Glass Mat Faced Products:
   a. Georgia-Pacific Gypsum; DensGlass Shaftliner (mold-resistant).
   b. National Gypsum Company; Gold Bond Fire-Shield Shaftliner XP.
   c. USG Corporation; Sheetrock Gypsum Liner Panels -- Enhanced (mold-resistant).

2.04 GYPSUM WALLBOARD ACCESSORIES
A. Sound Attenuation Batts: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3-1/2 inches.
B. Acoustic Sealant: As specified in Section 07 9200.
C. Finishing Accessories: ASTM C1047, rigid plastic, unless noted otherwise.
   1. Types: As detailed or required for finished appearance, including:
      a. Tear Away L Beads.
      b. Tear Away XTL Beads.
      c. Pullaway L Beads.
      d. Shower Beads.
      e. Flat Tear Aways.
   2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead, L-bead, and LC-bead at exposed panel edges as detailed or required for finished appearance.
   3. Manufacturers - Finishing Accessories:
      b. Substitutions - See Division One.

D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.
F. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.
G. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
   1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.

3.03 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
   1. Level ceiling system to a tolerance of 1/1200.
   2. Laterally brace entire suspension system.
C. Studs: Space studs as indicated.
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
D. Furring for Fire Ratings: Install as required for fire resistance ratings indicated and to GA-600 requirements.
E. Blocking: Install mechanically fastened steel channel blocking for support of:
   1. Wall mounted cabinets.
   2. Toilet accessories.
   3. Wall mounted door hardware.
   4. Wall-mounted handrails.
   5. Other items requiring blocking for support.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

A. Sound Attenuation Batts: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.05 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
C. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
D. Cementitious Backing Board: Install over steel framing members where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
E. Installation on Metal Framing: Use screws for attachment of gypsum board.

3.06 INSTALLATION OF TRIM AND ACCESSORIES
A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
B. Corner Beads: Install at external corners, using longest practical lengths.
C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

3.07 JOINT TREATMENT
A. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 3: Ceilings to receive textured finish.
   3. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.
C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

3.08 TEXTURE FINISH
A. Apply finish texture coating to ceilings by means of spraying apparatus in accordance with manufacturer's instructions.
B. Texture Required: Orange peel.

3.09 TOLERANCES
A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Suspended metal grid ceiling system.
   B. Acoustical units.

1.02 REFERENCE STANDARDS

1.03 ADMINISTRATIVE REQUIREMENTS
   A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
   B. Do not install acoustical units until after interior wet work is dry.

1.04 SUBMITTALS
   A. See Division One for submittal procedures.
   B. Product Data: Provide data on suspension system components and acoustical units.
   C. Samples: Submit two samples 6 x 6 inch in size illustrating material and finish of acoustical units.
   D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
   E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
      1. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.05 QUALITY ASSURANCE
   A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
   B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 FIELD CONDITIONS
   A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS / PRODUCTS
   A. Acoustic Panels:
      1. Basis-of-design manufacturer, product, color, and locations shown in the Finish Schedule on the Drawings.
         a. Substitutions: See Division One.
   B. Suspension Systems:
      1. Basis-of-design manufacturer, product, color, and locations shown in the Finish Schedule on the Drawings.
         a. Substitutions: See Division One.
2.02 ACCESSORIES
   A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic
      requirements, and ceiling system flatness requirement specified.
   B. Perimeter Moldings: Same metal and finish as grid.
   C. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify existing conditions before starting work.
   B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM
   A. Install suspension system in accordance with ASTM C636/C636M and manufacturer's
      instructions and as supplemented in this section.
   B. Rigidly secure system, including integral mechanical and electrical components, for maximum
      deflection of 1:360.
   C. Locate system on room axis according to reflected plan.
   D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with
      other interruptions.
      1. Use longest practical lengths.
   E. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where
      carrying members are spliced, avoid visible displacement of face plane of adjacent members.
   F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest
      affected hangers and related carrying channels to span the extra distance.
   G. Do not support components on main runners or cross runners if weight causes total dead load
      to exceed deflection capability.
   H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or
      support components independently.
   I. Do not eccentrically load system or induce rotation of runners.

3.03 INSTALLATION - ACOUSTICAL UNITS
   A. Install acoustical units in accordance with manufacturer's instructions.
   B. Fit acoustical units in place, free from damaged edges or other defects detrimental to
      appearance and function.
   C. Lay directional patterned units with pattern parallel to longest room axis.
   D. Fit border trim neatly against abutting surfaces.
   E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
   F. Cutting Acoustical Units:
      1. Make field cut edges of same profile as factory edges.

3.04 TOLERANCES
   A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
   B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION
SECTION 09 6500
RESILIENT FLOORING AND BASE

PART 1  GENERAL

1.01  SECTION INCLUDES
A. Resilient sheet flooring.
B. Resilient base.
C. Resilient stair accessories.
D. Installation accessories.

1.02  RELATED REQUIREMENTS
A. Section 09 0561 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.

1.03  SUBMITTALS
A. See Division One for Submittal Procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
C. Verification Samples: Submit two samples illustrating color and pattern for each resilient flooring product specified.
D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.04  QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.
B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.05  DELIVERY, STORAGE, AND HANDLING
A. Protect materials from damage. Store materials according to manufacturer's recommendations.

1.06  FIELD CONDITIONS
A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2  PRODUCTS

2.01  SHEET FLOORING
A. Vinyl Sheet Flooring: Homogeneous without backing, with color and pattern throughout full thickness.
   1. See finish schedule on drawings for basis-of-design manufacturer, product, color, and locations.
      a. Substitutions: See Division One.
   3. Thickness: 0.080 inch nominal.
2.02 STAIR COVERING

A. Stair Treads: Rubber; full width and depth of stair tread in one piece; tapered thickness; nosing not less than 1-5/8" thick.
   1. Nominal Thickness: 1/4 inch, minimum.
   3. See finish schedule on drawings for manufacturer, product, color, and locations.
      a. Substitutions: See Division One.

B. Stair Risers: Full height and width of tread in one piece, matching treads in material and color.
   1. Thickness: 1/8 inch, minimum.
   2. See finish schedule on drawings for manufacturer, product, color, and locations.
      a. Substitutions: See Division One.

2.03 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TP, rubber, thermoplastic; top set Style B, Cove.
   1. Height: 4 inch.
   2. Thickness: 1/8 inch thick, minimum.
   4. See finish schedule on drawings for manufacturer, product, color, and locations.
      a. Substitutions: See Division One.

2.04 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section 09 0561.
   2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. The flooring installer, flooring manufacturer, and adhesive manufacturer are responsible for reviewing and approving the testing agency's recommended remediation methods and products, OR recommending remediation methods and products that are acceptable to the testing agency.

B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

C. Prohibit traffic until filler is fully cured.
3.03 INSTALLATION - GENERAL
A. Starting installation constitutes acceptance of subfloor conditions.
B. Install in accordance with manufacturer's written instructions.
C. Spread only enough adhesive to permit installation of materials before initial set.
D. Fit joints and butt seams tightly.
E. Set flooring in place, press with heavy roller to attain full adhesion.
F. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
G. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - SHEET FLOORING
A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.

3.05 INSTALLATION - RESILIENT BASE
A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
B. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.06 INSTALLATION - STAIR COVERINGS
A. Install stair coverings in one piece for full width and depth of tread.
B. Adhere over entire surface. Fit accurately and securely.

3.07 CLEANING
A. Remove excess adhesive from floor, base, and wall surfaces without damage.
B. Clean in accordance with manufacturer's written instructions.

3.08 PROTECTION
A. Prohibit traffic on resilient flooring for 48 hours after installation.

3.09 SCHEDULE
A. See finish schedule on drawings for manufacturer, product, locations, and colors.

END OF SECTION
SECTION 09 6700
FLUID-APPLIED FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Fluid-applied flooring and base.

1.02 SUBMITTALS
A. See Division One for Submittal Procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.
C. Samples: Submit two samples, 4 x 4 inch in size illustrating color and pattern for each floor material for each color specified.
D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
F. Manufacturer's Qualification Statement.
G. Applicator's Qualification Statement.
H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

1.03 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
B. Applicator Qualifications: Company specializing in performing the work of this section.
  1. Minimum three years of documented experience.
  2. Approved by manufacturer.

1.04 MOCK-UP
A. Construct mock-up(s) of fluid applied flooring to serve as basis for evaluation of texture and workmanship.
  1. Number of Mock-Ups to be Prepared: One.
  2. Use same materials and methods for use in the work.
  3. Locate where directed.
B. Obtain approval of mock-up by Owner's Representative and Architect before proceeding with work.
C. Approved mock-up may remain as part of the Work.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Store resin materials in a dry, secure area.
B. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.06 FIELD CONDITIONS
A. Maintain minimum temperature in storage area of 55 degrees F.
B. Store materials in area of installation for minimum period of 24 hours prior to installation.
C. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fluid-Applied Flooring:
   2. Other manufacturers:
   3. Substitutions: See Division One.

2.02 FLUID-APPLIED FLOORING SYSTEMS

A. Fluid-Applied Flooring: Epoxy, no aggregate.
   1. System Thickness: 19 mils, nominal, when dry.
   2. Texture: Slip resistant.
   3. Color: As noted in Finish Legend on Drawings..
      a. HD WB Primer; 6 mils.
      b. PRO100 Epoxy; 13 mils.
      c. Anti-Slip Additive (HWS).

2.03 ACCESSORIES

A. Divider Strips: Zinc, height to match flooring thickness, with anchoring features.
B. Control Joint Strips: Match divider strips.
C. Base Caps and Separator Strips: Match divider strips.
D. Cant Strips: Molded material compatible with flooring.
E. Subfloor Filler: Type recommended by fluid-applied flooring manufacturer.
F. Primer: Type recommended by fluid-applied flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.
B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive flooring.
C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of materials to subfloor surfaces.
D. Cementitious Subfloor Surfaces: Verify that substrates are ready for fluid-applied flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section 09 0561.
   2. Obtain instructions if test results are not within limits recommended by fluid-applied flooring manufacturer.
   3. Follow moisture and alkalinity remediation procedures in Section 09 0561.
E. Verify that required floor-mounted utilities are in correct location.
3.02 PREPARATION
   A. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.
   B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.
   C. Vacuum clean substrate.
   D. Apply primer to surfaces required by flooring manufacturer.

3.03 INSTALLATION - ACCESSORIES
   A. Install cant strips at base of walls where flooring is to be extended up wall as base.
   B. Install terminating cap strip at top of base; attach securely to wall substrate.

3.04 INSTALLATION - FLOORING
   A. Apply in accordance with manufacturer's instructions.
   B. Apply each coat to minimum thickness required by manufacturer.
   C. Finish to smooth level surface.
   D. Cove at vertical surfaces.

3.05 PROTECTION
   A. Prohibit traffic on floor finish for 48 hours after installation.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.
B. Field application of paints including designated floors.
C. Specified testing of substrates.
D. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
   1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
   2. Pipe Railings.
   3. Mechanical and Electrical:
      a. In finished areas, paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
   4. All items noted on drawings to be painted.
E. Do Not Paint or Finish the Following Items:
   1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Non-metallic roofing and flashing.
   6. Stainless steel, anodized aluminum, bronze, terne, and lead items.
   7. Glass.
   8. Acoustical materials, unless specifically so indicated.
   9. Concealed pipes, ducts, and conduits.

1.02 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.

1.03 SUBMITTALS

A. See Division One, for submittal procedures.
B. Product Data: Provide complete list of all products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
   3. Manufacturer's installation instructions.
   4. If proposal of substitutions is allowed under submittal procedures, explanation of all substitutions proposed.
C. Samples: Submit two painted samples, illustrating selected colors for each color and system selected with specified coats cascaded. Submit on tempered hardboard, 12x12 inch in size.
D. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.
E. Certification: By manufacturer that all paints and coatings do not contain any of the prohibited chemicals specified; GreenSeal GS-11 certification is not required but if provided shall constitute acceptable certification.

F. Results of all required testing.

G. Manufacturer’s Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention.

H. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

I. Maintenance Materials: Furnish the following for Owner’s use in maintenance of project.
   1. Extra Paint and Coatings: 1 gallon of each color; store where directed.
   2. Label each container with color in addition to the manufacturer’s label.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum ten years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer’s name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer’s instructions.

1.06 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer’s recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer’s instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.

B. Paints:

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: See Division One.
2.02 PAINTS AND COATINGS - GENERAL

A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
   1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
   4. Supply each coating material in quantity required to complete entire project's work from a single production run.
   5. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.

B. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.

C. Volatile Organic Compound (VOC) Content:
   1. Provide coatings that comply with the most stringent requirements specified in the following:
   2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

D. Chemical Content: The following compounds are prohibited:
   1. Aromatic Compounds: In excess of 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
   2. Acrolein, acrylonitrile, antimony, benzene, butyl benzyl phthalate, cadmium, di (2-ethylhexyl) phthalate, di-n-butyl phthalate, di-n-octyl phthalate, 1,2-dichlorobenzene, diethyl phthalate, dimethyl phthalate, ethylbenzene, formaldehyde, hexavalent chromium, isophorone, lead, mercury, methyl ethyl ketone, methyl isobutyl ketone, methylene chloride, naphthalene, toluene (methylbenzene), 1,1,1-trichloroethane, vinyl chloride.

E. Flammability: Comply with applicable code for surface burning characteristics.

F. Colors: As indicated on drawings in finish schedule.
   1. Extend colors to surface edges; colors may change at any edge as directed by Architect.
   2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.03 PAINT SYSTEMS - INTERIOR

A. All Interior Surfaces Indicated to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry, shop primed steel, and galvanized steel.
   1. Two top coats and one coat primer.
   2. Eggshell: MPI gloss level 3; use this sheen at all locations.
   3. Top Coat Product(s):
   4. Primer(s): As recommended by manufacturer of top coats.

B. Interior Ferrous Metal Galvanized and Non-Galvanized; Handrails, hollow metal frames and other ferrous metal items shown on drawings to be painted.
1. Two top coats and one coat primer.
2. Semi-Gloss.
3. Top Coat Product(s):
   a. Latex, interior, semi-gloss: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
4. Primer(s): SW Pro-Cryl Universal Primer, B66-310.

2.04 ACCESSORY MATERIALS
A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
B. Patching Material: Latex filler.
C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION
3.01 EXAMINATION
A. Do not begin application of coatings until substrates have been properly prepared.
B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
E. Test shop-applied primer for compatibility with subsequent cover materials.
F. Moisture Testing: Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Gypsum Wallboard: 12 percent.

3.02 PREPARATION
A. Clean surfaces thoroughly and correct defects prior to coating application.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
C. Remove or repair existing coatings that exhibit surface defects.
D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
E. Seal surfaces that might cause bleed through or staining of topcoat.
F. Remove mildew from impervious surfaces by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
G. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
H. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
I. Corroded Steel and Iron Surfaces to be Painted: Prepare using at least SSPC-PC 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).
J. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of
phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.

K. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's instructions.

C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance.

F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

G. Sand metal surfaces lightly between coats to achieve required finish.

H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finished coatings until completion of project.

B. Touch-up damaged coatings after Substantial Completion.

END OF SECTION
SECTION 10 2116
SHOWER COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Solid surface shower base, enclosure, and accessories.

1.02 REFERENCE STANDARDS

1.03 ADMINISTRATIVE REQUIREMENTS
A. Coordination: Coordinate the work of this Section with plumbing fixtures and requirements as noted in Division 22.

1.04 SUBMITTALS
A. See Division One for submittals procedures.
B. Product Data: Provide manufacturer's catalog literature indicating typical construction details, typical installation details, material descriptions, finishes, dimensions, and profiles.
C. Shop Drawings: Indicate rough-in dimensions.
D. Samples: For each finish product specified, two complete sets of color chips representing the manufacturer's full range of available colors and patterns.

1.05 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS
B. Substitutions: See Division One.

2.02 PRODUCTS
A. Onyx Collection standard shower assembly:
   1. Base: 60"x32" Low Profile, Center Drain with Add-on Ramp.
   2. Walls: 78-inches tall.
   3. Color / Finish: To be selected by Architect from manufacturer's full range of colors/finishes.
B. Materials:
   1. (PMMA) Acrylic solid-surface.
   2. Surface Burning Characteristics - Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
C. Accessories
   1. Silicone sealant color-matched to panels and as recommended by manufacturer.
PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify adequacy of backing and support framing.
C. Verify that blocking has been installed for grab bars, seating and other shower accessories related to the work of this section.
D. Verify location and sizes of utility rough-in associated with work of this section.
E. Verify that field measurements are as indicated on product data.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.03 CLEANING

A. Clean shower base, walls, and adjacent surfaces affected by work of this Section.

3.04 PROTECTION

A. Protect installed shower base and walls from subsequent construction operations.
B. Do not permit traffic over unprotected floor surface.

END OF SECTION
SECTION 10 2800
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Accessories for toilet rooms.
   B. Grab bars.

1.02 ADMINISTRATIVE REQUIREMENTS
   A. Coordinate the work with the placement of internal wall reinforcement to receive anchor attachments.

1.03 SUBMITTALS
   A. See Division One for submittal procedures.
   B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
   C. Manufacturer’s Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS
2.01 MANUFACTURERS
   A. Toilet Accessories: See Schedule on Drawings for specific accessories, basis-of-design manufacturers, and locations. The schedule on the drawings designates any items that will be supplied by the Owner for installation by the Contractor.
      1. Substitutions: See Division One.
   B. All items of each type to be made by the same manufacturer.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify existing conditions before starting work.
   B. Verify exact location of accessories for installation.
   C. Verify that field measurements are as indicated on product data.

3.02 PREPARATION
   A. Deliver inserts and rough-in frames to site for timely installation.
   B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION
   A. Install accessories in accordance with manufacturers’ instructions in locations indicated on drawings.
   B. Install plumb and level, securely and rigidly anchored to substrate.
   C. Mounting Heights: As required by accessibility regulations and as indicated on Drawings.

3.04 SCHEDULE
   A. See Restroom Accessory Schedule on Drawings.

END OF SECTION
SECTION 10 4400
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Fire extinguishers.
   B. Fire extinguisher cabinets.

1.02 SUBMITTALS
   A. See Division One for Submittal Procedures.
   B. Shop Drawings: Indicate cabinet physical dimensions, rough-in measurements for recessed
cabinets, and all installation details.
   C. Product Data: Provide extinguisher operational features, color and finish, and anchorage
details.
   D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination
   requirements.
   E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.03 FIELD CONDITIONS
   A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher
   ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Fire Extinguishers:
      2. Substitutions: See Division One.
   B. Fire Extinguisher Cabinets:
      1. Basis of Design: JL Industries, Inc; Product Ambassador Series No. 1816-F-18,
      2. Substitutions: See Division One.

2.02 FIRE EXTINGUISHERS
   A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable
codes, whichever is more stringent. Provide extinguishers labeled by UL for the purpose
specified and indicated.
   1. Where shown: Dry Chemical Type Fire Extinguishers; Carbon steel tank, with pressure
gage.
      b. Class: 4-A:60-B:C.
      c. Size: 10 pound.
      d. Finish: Baked polyester powder coat, red color.
      e. Temperature range: -65 degrees F to 120 degrees F.
   2. 

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify existing conditions before starting work.
B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Secure rigidly in place.
C. Place extinguishers in cabinets.

END OF SECTION
SECION 11 3013
RESIDENTIAL APPLIANCES

PART 1  GENERAL

1.01  SECTION INCLUDES
   A.  Kitchen appliances.
   B.  Laundry appliances.

1.02  SUBMITTALS
   A.  See Division One for Submittal Procedures.
   B.  Product Data:  Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.
   C.  Copies of Warranties:  Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03  QUALITY ASSURANCE
   A.  Manufacturer Qualifications:  Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
   B.  Electric Appliances:  Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).

PART 2  PRODUCTS

2.01  KITCHEN APPLIANCES
   B.  Refrigerator:  Free-standing, top-mounted freezer, and frost-free.
   1.  Capacity:  Total minimum storage of 20 cubic ft; minimum 15 percent freezer capacity.
   2.  Features:  Include glass shelves, automatic icemaker, light in freezer compartment, and in-door water and ice dispenser.
   4.  Manufacturers:
      c.  GE Appliances:  www.geappliances.com/#sle.
      e.  Substitutions:  See Division One.
   C.  Range:  Electric, free-standing, with glass-ceramic cooktop.
      1.  Size:  30 inches wide.
      2.  Oven:  Self-cleaning.
      4.  Features:  Include storage drawer, oven door window, and oven light.
      6.  Manufacturers:
         c.  GE Appliances:  www.geappliances.com/#sle.
         e.  Substitutions:  See Division One.
   D.  Cooking Exhaust:  Range hood.

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1. Size: 30 inches wide.
2. Exhaust: Recirculating.
3. Features: Include cooktop light and removable grease filter.
5. Manufacturers:
   c. GE Appliances: www.geappliances.com/#sle.
   e. Substitutions: See Division One.

E. Microwave: Countertop.
1. Capacity: 1.1 cubic ft.
4. Manufacturers:
   c. GE Appliances: www.geappliances.com/#sle.
   e. Substitutions: See Division One.

F. Dishwasher: Undercounter.
2. Cycles: Six (6), including normal, rinse and hold, short, china/crystal, pot and pan, and Auto.
3. Features: Include rinse aid dispenser, optional no-heat dry, and adjustable upper rack.
5. Manufacturers:
   c. GE Appliances: www.geappliances.com/#sle.
   e. Substitutions: See Division One.

2.02 LAUNDRY APPLIANCES

A. Provide Washer and Dryer from a single manufacturer.
B. Provide Stacking Kit per manufacturer requirements.
C. Clothes Washer: Front-loading.
   1. Size: Large capacity.
   2. Controls: Solid state electronic.
   5. Finish: Painted steel, color white.
   6. Manufacturers:
      c. GE Appliances: www.geappliances.com/#sle.
      e. Substitutions: See Division One.
D. Clothes Dryer: Electric, stationary.
   1. Size: Large capacity.
   2. Controls: Solid state electronic, with electronic moisture-sensing dry control.
   3. Temperature Selections: Four.
   5. Finish: Painted steel, color white.
   6. Manufacturers:
      c. GE Appliances: www.geappliances.com/#sle.
      e. Substitutions: See Division One.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify utility rough-ins are provided and correctly located.

3.02 INSTALLATION
   A. Install in accordance with manufacturer's instructions.

3.03 ADJUSTING
   A. Adjust equipment to provide efficient operation.

3.04 CLEANING
   A. Remove packing materials from equipment and properly discard.
   B. Wash and clean equipment.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Interior manual roller shades.

1.02 ADMINISTRATIVE REQUIREMENTS
A. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
   2. Do not install shades until final surface finishes and painting are complete.

1.03 SUBMITTALS
A. See Division One for Submittal Procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, and mounting dimension requirements for each product and condition.
D. Selection Samples: Include fabric samples in full range of available colors and patterns.
E. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.04 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
B. Handle and store shades in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Interior Manually Operated Roller Shades:
   4. Substitutions: See Division One.

2.02 ROLLER SHADES
A. General:
   1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
   2. Provide shade system that operates smoothly when shades are raised or lowered.
B. Roller Shades:
1. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.

2. Roller Tubes: As required for type of shade operation.

3. Hembars: Designed to maintain bottom of shade straight and flat.

4. Manual Operation for Interior Shades:
   a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
   b. Drive Chain: Continuous loop beaded ball chain, 95 pounds minimum breaking strength. Provide upper and lower limit stops.
   c. Chain Retainer:
      1) Chain tensioning device complying with WCMA A100.1.
      2) Manufacturer's standard clip.

5. Fabric:
   a. Hunter Douglas "Avila Twilight".
      1) Polyester and Acrylic fabric.
      2) Weight: 14.5 oz/sq. yd.
      3) Thickness: 0.020 inch.
      4) Openness: 0 percent.
      5) UV Blockage: 100 percent.
      6) Color: As selected by Architect from Manufacturer's standard range.

2.03 ROLLER SHADE FABRICATION
   A. Field measure finished openings prior to ordering or fabrication.
   B. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Examine finished openings for deficiencies that may preclude satisfactory installation.
   B. Start of installation shall be considered acceptance of substrates.

3.02 INSTALLATION
   A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
   B. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.03 CLEANING
   A. Clean soiled shades and exposed components as recommended by manufacturer.
   B. Replace shades that cannot be cleaned to "like new" condition.

3.04 PROTECTION
   A. Protect installed products from subsequent construction operations.
   B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION
SECTION 21 0100
BASIC FIRE PROTECTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Specification Sections, apply to this and the other sections of Division 21.

1.2 SUMMARY
   A. This Section includes general administrative and procedural requirements for fire protection installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
      1. Submittals.
      3. Coordination drawings.
      4. Record documents.
      5. Maintenance manuals.

1.3 REFERENCED STANDARDS
   A. International Fire Code 2012 (IFC)
   B. National Fire Protection Association Standards
   C. General: Submittals are not requested for all products covered in the specifications. Submit only the data requested under the submittals portion of each specification section or where indicated in a Submittal Log, if included within Division 01. Un-requested submittals will not be processed, reviewed or returned and the contractor will be notified that the submittal will not be reviewed by the engineer of record.
      1. Non-requirement of submittals, when so noted, is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.
      2. Any deviation from specified items is considered a substitution. If the contractor desires to use other than specified items, then a formal request for substitution must be submitted prior to bid date (no exceptions), in accordance with the procedures and time limitations set forth in Division 01. Where not defined in Division 01, requests for substitutions shall be submitted no less than ten (10) working days prior to bid date. Review of substitution requests by the Engineer shall be done at the expense of the contractor. Charges for this substitution review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.
      D. It is the responsibility of the Contractor to ensure that all submittals have been reviewed for total completeness and accuracy as to the requirements of the specifications and drawings before being submitted to the Engineer for review.
         1. One comprehensive submittal shall be provided for each individual specification section. All required submittal information called for in each individual specification section shall be included in the submittal.
         2. The Engineer of Record shall not be responsible for informing the contractor on items that have not been included and are necessary for a complete review of the required submittal information for a specification section.
         3. The Engineer of Record shall have the option of returning any submittal, unmarked, if all required documentation called for in the specifications has not been provided in the submittal.
         4. The Engineer of Record shall review each submittal no more than two (2) times and return to the contractor with the appropriate disposition.
5. If the Engineer of Record is required to review a submittal a second time, it shall be limited to review of the changed information, clearly highlighted by the submitter, and/or confirmation of documentation only and it shall be returned to the contractor with the appropriate disposition.

6. If the submittal is required to be reviewed a third time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer’s standard hourly rates, as defined in their contract with the Owner.

E. Operation and Maintenance Manuals: All items required for insertion into each Operation and Maintenance (O&M) Manual are called out in the submittals portion of each specification section or in a Submittal Log, if included within Division 01. It is the responsibility of the Contractor to ensure that the O&M submittal has been reviewed and includes all the requirements of the specifications. The Engineer of Record shall review the submittal for the Operation and Maintenance Manual one (1) time and return to the contractor with the appropriate disposition.

1. If the submittal is required to be reviewed a second time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer’s standard hourly rates, as defined in their contract with the Owner.

2. Submittals for the Operation and Maintenance Manual must be original documentation.

3. Photo copies of marked up Operations and Maintenance submittals are not acceptable.

F. Refer to Division 01 and each individual Division 21 Section for additional submittal requirements.

G. Prepare maintenance manuals in accordance with Division 01. In addition to the requirements specified in Division 01, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

5. Facsimiles or photo copies are not allowed as submittals for operating and maintenance manuals. Submittals for operating and maintenance manuals must be on original manufacturer printed stock.

H. Prepare and submit Coordination Drawings as further described herein. The Engineer shall receive one copy of all coordination drawings supplied to the Owner as required in this specification. It is the responsibility of the Contractor to coordinate the work as outlined herein. Receipt by the Engineer of a copy of the coordination drawings is to verify conformance to the submittal requirements set forth in this specification section. It is not an admission by the Engineer as to the accuracy or completeness of the coordination proposed.

I. Coordination shall be drawn to a scale of ¼” = 1’0” or larger. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation.
and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:

1. Planned piping layout, including valve and specialty locations and valve-stem movement. Include all piping including but not limited to Fire Protection piping, HVAC piping, and Plumbing piping. Include ceiling and wall-mounted access doors and panels required to provide access to valves and other operating devices.

2. Planned ductwork layout, including terminal units, dampers and specialty locations, with terminal unit and damper operator clearances. Include ceiling and wall-mounted access doors and panels required to provide access to dampers and other operating devices.

3. Clearances for installing and maintaining insulation.

4. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.

5. Equipment and accessory service connections and support details.


7. Fire-rated wall and floor penetrations.

8. Sizes and location of required concrete pads and bases.

9. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.

10. Floor plans, elevations, and details to indicate penetrations in floors, walls, ceilings and roofs, and their relationship to other penetrations and installations.

11. Ceiling plans showing coordination of mechanical, electrical, structural, ceiling suspension assembly, lighting, security, communications, fire alarm, plumbing, and fire protection work within allotted space.

12. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, access panels, special moldings, and other ceiling-mounted items.

Floor plans and sections of fan rooms and mechanical rooms; show layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

J. Prepare record documents in accordance with the requirements in Division 01. In addition to the requirements specified in Division 01, indicate the following installed conditions:

1. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located. Indicate actual inverts and horizontal locations of all underground piping.

2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.


K. Comply with each individual Division 21 Section for additional submittal requirements.

1.4 MATERIAL AND EQUIPMENT SELECTION

A. Product Options: The specification of each item of major mechanical equipment required for the project may include a list of manufacturers, with one "basis of design" manufacturer, type, and model identified by virtue of their listing in the equipment schedule on the Drawings. Where several manufacturers in addition to the "basis of design" manufacturer are listed in the specifications, it shall be understood that the words "or approved equal by" are implied to precede each of the other manufacturer's names.

1. The manufacturers other than the "basis of design" may be furnished at the contractor's option in lieu of the "basis of design" product, provided that the selected manufacturer's product is equal in all material and functional respects. In addition to submittal requirements that may be specified in this section, submit a...
line-by-line written verification of the applicable specification section(s) identifying compliance with or variations from the specified features, materials, performance, capacities, weight, size, durability, energy consumption and efficiency, warranty, and visual impact (if exposed to view by other than maintenance persons). The burden of proof of manufacturer/product equality is on the contractor.

2. Where a product is not scheduled on the drawings and, therefore, where no “basis of design” is indicated, selection among all of the listed manufacturers and products is at the contractor’s option, subject to the requirements of the Contract Documents.

3. Products of manufacturers not listed in the Contract Documents are considered Substitutions and are not permitted, except as provided under the General and Supplementary Conditions and Division 01 Specifications. Full compliance with Division 01 section “Product Substitutions” is mandatory for acceptance of products or manufacturers not listed.

B. Listing of a manufacturer does not imply approval of that manufacturer’s standard product or products. Rather, listing of a manufacturer indicates only a general acceptance of that manufacturer’s name and reputation. Final approval is subject to full compliance with these Contract Documents.

C. Model numbers identified on the Drawings notwithstanding, all equipment must comply with the requirements of these Contract Documents. Do not assume that a manufacturer’s standard product is acceptable as is. For example, one or more custom modifications, custom colors or finishes, manufacturer’s options, and/or accessories may be required to meet the specified requirements.

D. Where drawings indicate sizes, profiles, connections, and dimensional requirements of material and equipment, these are based on the “basis of design” manufacturer, type and model indicated. In the event that equipment of power, dimensions, capacities, layout, connections, and/or ratings differing from the “basis of design” are selected by the contractor and approved by the Owner’s representative, any necessary adjustments are the contractor’s responsibility. All connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, pipe and duct sizes, pipe and duct layout, and the like shall be adjusted by the contractor to suit the equipment provided. No additional costs will be approved for these changes. Should revisions to the design because of contractor’s selection of manufacturer, type, or model other than the “basis of design” require additional review and/or redesign by an Architect or Engineer, the contractor shall reimburse the Owner for Owner’s added professional fee expenses.

E. Where two or more materials are listed in the “Part 2 – Products” subsection of any Division 21 section, do not assume that the selection of materials is the contractor’s option. Refer to “Part 3 – Execution” subsection of that same Division 21 section for an explanation of which specific material(s) shall be used for which specific application(s). For example, Part 2 may list several types and grades of piping, and Part 3 will describe which type and grade of pipe to use for a given application.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Protect stored on-site or installed absorptive materials from moisture damage. Materials directly exposed to moisture via precipitation, water leaks, or condensation shall be removed from the jobsite and replaced.

END OF SECTION
SECTION 21 0500
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

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

1.02 SUMMARY
   A. This Section includes the following:
      1. Piping materials and installation instructions common to most piping systems.
      2. Mechanical sleeve seals.
      3. Sleeves.
      4. Escutcheons.
      5. Grout.
      6. Fire-suppression equipment and piping demolition.
      7. Equipment installation requirements common to equipment sections.
      8. Painting and finishing.
      9. Concrete bases.
     10. Supports and anchorages.

1.03 DEFINITIONS
   A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
   B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
   C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
   D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
   E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
   F. The following are industry abbreviations for rubber materials:
      1. EPDM: Ethylene-propylene-diene terpolymer rubber.
      2. NBR: Acrylonitrile-butadiene rubber.

1.04 CONTRACTOR'S SUBMITTAL REVIEW RESPONSIBILITIES
   A. General: Submittals are not requested for all products covered in the specifications. Submit only the data requested under the submittals portion of each specification section or where indicated in a Submittal Log, if included within Division 01. Un-requested submittals will not be processed, reviewed or returned and the contractor will be notified that the submittal will not be reviewed by the engineer of record.
      1. Non-request of submittals, when so noted, is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.
2. Any deviation from specified items is considered a substitution. If the contractor desires to use other than specified items, then a formal request for substitution must be submitted prior to bid date (no exceptions), in accordance with the procedures and time limitations set forth in Division 01. Where not defined in Division 01, requests for substitutions shall be submitted no less than ten (10) working days prior to bid date. Review of substitution requests by the Engineer shall be done at the expense of the contractor. Charges for this substitution review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.

B. It is the responsibility of the Contractor to ensure that all submittals have been reviewed for total completeness and accuracy as to the requirements of the specifications and drawings before being submitted to the Engineer for review.

1. One comprehensive submittal shall be provided for each individual specification section. All required submittal information called for in each individual specification section shall be included in the submittal.

2. The Engineer of Record shall not be responsible for informing the contractor on items that have not been included and are necessary for a complete review of the required submittal information for a specification section.

3. The Engineer of Record shall have the option of returning any submittal, unmarked, if all required documentation called for in the specifications has not been provided in the submittal.

4. The Engineer of Record shall review each submittal no more than two (2) times and return to the contractor with the appropriate disposition.

5. If the Engineer of Record is required to review a submittal a second time, it shall be limited to review of the changed information, clearly highlighted by the submitter, and/or confirmation of documentation only and it shall be returned to the contractor with the appropriate disposition.

6. If the submittal is required to be reviewed a third time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.

C. Operation and Maintenance Manuals: All items required for insertion into each Operation and Maintenance (O&M) Manual are called out in the submittals portion of each specification section or in a Submittal Log, if included within Division 01. It is the responsibility of the Contractor to ensure that the O&M submittal has been reviewed and includes all the requirements of the specifications. The Engineer of Record shall review the submittal for the Operation and Maintenance Manual one (1) time and return to the contractor with the appropriate disposition.

1. If the submittal is required to be reviewed a second time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.

2. Submittals for the Operation and Maintenance Manual must be original documentation.

3. Photo copies of marked up Operations and Maintenance submittals are not acceptable.

D. Coordination Drawings: Prepare and submit Coordination Drawings as further described herein and as indicated in the Special Conditions. The Engineer shall receive one copy of all coordination drawings supplied to the Owner as required in this specification. It is the responsibility of the Contractor to coordinate the work as outlined herein. Receipt by the Engineer of a copy of the coordination drawings is to verify conformance to the submittal
requirements set forth in this specification section. It is not an admission by the Engineer as to the accuracy or completeness of the coordination proposed.

E. Refer to Division 01 and each individual Division 23 Section for additional submittal requirements.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.06 COORDINATION
A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS
A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS
A. Refer to individual Division 21 piping Sections for special joining materials not listed below.

2.04 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.

2.05 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, Stamped-Steel Type: With set screw and chrome-plated finish.

PART 3 - EXECUTION

3.01 FIRE-SUPPRESSION DEMOLITION
A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
B. Disconnect, demolish, and remove fire-suppression systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Equipment to Be Removed: Disconnect and cap services and remove equipment.
3. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

4. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

   1. New Piping:

      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.

      c. Insulated Piping: One-piece, stamped-steel type with spring clips.

      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

      e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.

      f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.

      g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.

      h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.

      i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.
j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.
N. Permanent sleeves are not required for holes formed by removable PE sleeves.
O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. PVC Pipe Sleeves: For pipes smaller than NPS 6.
   b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

S. Verify final equipment locations for roughing-in.
T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.03 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. 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.

E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.04 PAINTING

A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

END OF SECTION
SECTION 21 1119
FIRE-DEPARTMENT CONNECTIONS

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Exposed-type fire-department connections.

1.03 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each fire-department connection.

PART 2 - PRODUCTS

2.01 FLUSH-TYPE FIRE-DEPARTMENT CONNECTION
A. Standard: UL 405.
B. Type: Flush, for wall mounting.
C. Pressure Rating: 175 psig minimum.
D. Body Material: Corrosion-resistant metal.
E. Inlets: Brass with threads according to NFPA 1963. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
F. Caps: Brass, lugged type, with gasket and chain.
G. Escutcheon Plate: Rectangular, brass, wall type.
H. Outlet: With pipe threads.
I. Body Style: Horizontal.
J. Number of Inlets: Three.
K. Outlet Location: Top.
L. Escutcheon Plate Marking: Similar to "AUTO SPKR."
M. Finish: Rough chrome plated.
N. Outlet Size: NPS 4" single Storz connection.
O. Contractor shall provide sign with red background and white letters identifying the type of connection and the name of the building it serves.

PART 3 - EXECUTION

3.01 EXAMINATION
A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fire-department connections.
B. Examine roughing-in for fire-suppression standpipe system to verify actual locations of piping connections before fire-department connection installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION
A. Install wall-type fire-department connections.
B. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

END OF SECTION
PART 1 - GENERAL

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

1.02 SUMMARY
   A. Section Includes:
      1. Pipes, fittings, and specialties.
      2. Fire-protection valves.
      4. Pressure gages.

1.03 DEFINITIONS
   A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.04 SYSTEM DESCRIPTIONS
   A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.
   B. Deluge Sprinkler System: Open sprinklers are attached to piping connected to water supply through deluge valve. Fire-detection system, in same area as sprinklers, opens valve. Water flows into piping system and discharges from attached sprinklers when valve opens.

1.05 PERFORMANCE REQUIREMENTS
   A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
   B. High-Pressure Piping System Component: Listed for 250-psig minimum working pressure.
   C. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
   D. Sprinkler system design shall be approved by authorities having jurisdiction.
      1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
      2. Sprinkler Occupancy Hazard Classifications:
         a. See FP Drawings.
      3. Minimum Density for Automatic-Sprinkler Piping Design:
         a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
         b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
         c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
         d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
         e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
      4. Maximum Protection Area per Sprinkler: Per UL listing.
      5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
         a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
         b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
         c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.
1.06 SUBMITTALS
A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.
C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
D. Qualification Data: For qualified Installer and professional engineer.
E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.
F. Fire-hydrant flow test report.
G. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
H. Field quality-control reports.
I. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE
A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 13, "Installation of Sprinkler Systems."
   2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.08 COORDINATION
A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.09 EXTRA MATERIALS
A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.
PART 2 - PRODUCTS

2.01 PIPING MATERIALS
   A. Comply with requirements in “Piping Schedule” Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.02 STEEL PIPE AND FITTINGS
   A. Standard Weight, Black-Schedule 40 Steel Pipe: ASTM A 53/A 53M, Type S – seamless, Grade B. Pipe ends may be factory or field formed to match joining method.
   C. Cast-Iron Unions: UL 860.
   D. Cast-Iron Flanges: ASME 16.1, Class 125.
   E. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
   G. Grooved-Joint, Steel-Pipe Appurtenances:
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         a. Tyco Fire & Building Products LP.
         b. Victaulic Company.
      2. Pressure Rating: 175 psig minimum.
      3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
      4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.03 PIPING JOINING MATERIALS
   A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
      1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
   B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.04 TRIM AND DRAIN VALVES
   A. General Requirements:
      2. Pressure Rating: 175 psig minimum.
   B. Angle Valves:
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         a. Fire Protection Products, Inc.
         b. United Brass Works, Inc.

2.05 SPECIALTY VALVES
   A. General Requirements:
2. Pressure Rating:
   a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.

3. Body Material: Cast or ductile iron.

4. Size: Same as connected piping.

5. End Connections: Flanged or grooved.

B. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.


4. Type: Automatic draining, ball check.


2.06 SPRINKLER SPECIALTY PIPE FITTINGS

A. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   d. Victaulic Company.


4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.

5. Size: Same as connected piping.

6. Inlet and Outlet: Threaded.

B. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.


4. Body Material: Cast- or ductile-iron housing with sight glass.

5. Size: Same as connected piping.

6. Inlet and Outlet: Threaded.

2.07 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Reliable Automatic Sprinkler Co., Inc.

2. Tyco Fire & Building Products LP.


B. General Requirements:

C. Automatic Sprinklers with Heat-Responsive Element:
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

1. Characteristics:
   a. Nominal 1/2-inch Orifice: With Discharge Coefficient K between 5.3 and 5.8.
   b. Nominal 17/32-inch Orifice: With Discharge Coefficient K between 7.4 and 8.2.

E. Sprinkler Finishes:
1. Chrome plated.
2. Bronze.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.08 ALARM DEVICES
A. Alarm-device types shall match piping and equipment connections.
B. Water-Flow Indicators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. System Sensor; a Honeywell company.
   c. Viking Corporation.
   d. Watts Industries (Canada) Inc.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
7. Design Installation: Horizontal or vertical.
C. Valve Supervisory Switches:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. System Sensor; a Honeywell company.
   3. Type: Electrically supervised.
   5. Design: Signals that controlled valve is in other than fully open position.

2.09 PRESSURE GAGES
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AMETEK; U.S. Gauge Division.
   2. Ashcroft, Inc.
   4. WIKA Instrument Corporation.
B. Standard: UL 393.
C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
D. Pressure Gage Range: 0 to 250 psig minimum.
E. Water System Piping Gage: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.01 PREPARATION
A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
B. Report test results promptly and in writing.

3.02 SERVICE-ENTRANCE PIPING
A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Division 21 Section "Facility Fire-Suppression Water-Service Piping."
B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Division 21 Section "Facility Fire-Suppression Water-Service Piping."
C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.03 WATER-SUPPLY CONNECTIONS
A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 22 Section "Domestic Water Piping."
B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements for backflow preventers in Division 22 Section "Domestic Water Piping Specialties."
C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.04 PIPING INSTALLATION
A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
C. Install a single air vent with a manual, automatic, or other approved connection near a high point of the system on each wet pipe system utilizing metallic pipe for air removal.
D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
H. Install sprinkler piping with drains for complete system drainage.
I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
K. Install alarm devices in piping systems.
L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
N. Fill sprinkler system piping with water.
O. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Division 21 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Division 21 Section "Fire-Suppression Systems Insulation."
P. Install sleeves for piping penetrations of walls, ceilings, and floors.
Q. Install sleeve seals for piping penetrations of concrete walls and slabs.
R. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.05 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.06 VALVE AND SPECIALTIES INSTALLATION
A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
   1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

3.07 SPRINKLER INSTALLATION
A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

3.08 FIRE-DEPARTMENT CONNECTION INSTALLATION
A. Install wall-type, fire-department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.09 IDENTIFICATION
A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL
A. Perform tests and inspections.

B. Tests and Inspections:
   1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   4. Energize circuits to electrical equipment and devices.
   5. Start and run excess-pressure pumps.
   6. Coordinate with fire-alarm tests. Operate as required.
   7. Coordinate with fire-pump tests. Operate as required.
   8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
D. Prepare test and inspection reports.

3.11 CLEANING
A. Clean dirt and debris from sprinklers.
B. Remove and replace sprinklers with paint other than factory finish.

3.12 PIPING SCHEDULE
A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
B. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be the following:
   1. Standard-weight Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
C. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be the following:
   1. Standard-weight Schedule 40, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.13 SPRINKLER SCHEDULE
A. Use sprinkler types in subparagraphs below for the following applications:
   1. Rooms without Ceilings: Upright sprinklers.
   2. Rooms with Suspended Ceilings: Concealed sprinklers.
   4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.
   5. Special Applications: Concealed gasketed sprinklers where indicated on plans.
B. Provide sprinkler types in subparagraphs below with finishes indicated.
   1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
   2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
   3. Recessed Sprinklers: White plate, with white escutcheon.
   4. Residential Sprinklers: Dull chrome.
   5. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Specification Sections, apply to this and the other sections of Division 22.

1.02 SUMMARY
   A. This Section includes general administrative and procedural requirements for plumbing installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
      1. Submittals.
      3. Coordination drawings.
      4. Record documents.
      5. Maintenance manuals.

1.03 REFERENCED STANDARDS
   A. International Plumbing Code 2015 (IPC)

1.04 CONTRACTOR’S SUBMITTAL REVIEW RESPONSIBILITIES
   A. General: Submittals are not requested for all products covered in the specifications. Submit only the data requested under the submittals portion of each specification section or where indicated in a Submittal Log, if included within Division 01. Un-requested submittals will not be processed, reviewed or returned and the contractor will be notified that the submittal will not be reviewed by the engineer of record.
      1. Non-requirement of submittals, when so noted, is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.
      2. Any deviation from specified items is considered a substitution. If the contractor desires to use other than specified items, then a formal request for substitution must be submitted prior to bid date (no exceptions), in accordance with the procedures and time limitations set forth in Division 01. Where not defined in Division 01, requests for substitutions shall be submitted no less than ten (10) working days prior to bid date. Review of substitution requests by the Engineer shall be done at the expense of the contractor. Charges for this substitution review shall be calculated based on the Engineer’s standard hourly rates, as defined in their contract with the Owner.

   B. It is the responsibility of the Contractor to ensure that all submittals have been reviewed for total completeness and accuracy as to the requirements of the specifications and drawings before being submitted to the Engineer for review.
      1. One comprehensive submittal shall be provided for each individual specification section. All required submittal information called for in each individual specification section shall be included in the submittal.
      2. The Engineer of Record shall not be responsible for informing the contractor on items that have not been included and are necessary for a complete review of the required submittal information for a specification section.
      3. The Engineer of Record shall have the option of returning any submittal, unmarked, if all required documentation called for in the specifications has not been provided in the submittal.
4. The Engineer of Record shall review each submittal no more than two (2) times and return to the contractor with the appropriate disposition.

5. If the Engineer of Record is required to review a submittal a second time, it shall be limited to review of the changed information, clearly highlighted by the submitter, and/or confirmation of documentation only and it shall be returned to the contractor with the appropriate disposition.

6. If the submittal is required to be reviewed a third time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer’s standard hourly rates, as defined in their contract with the Owner.

C. Operation and Maintenance Manuals: All items required for insertion into each Operation and Maintenance (O&M) Manual are called out in the submittals portion of each specification section or in a Submittal Log, if included within Division 01. It is the responsibility of the Contractor to ensure that the O&M submittal has been reviewed and includes all the requirements of the specifications. The Engineer of Record shall review the submittal for the Operation and Maintenance Manual one (1) time and return to the contractor with the appropriate disposition.

1. If the submittal is required to be reviewed a second time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer’s standard hourly rates, as defined in their contract with the Owner.

2. Submittals for the Operation and Maintenance Manual must be original documentation.

3. Photo copies of marked up Operations and Maintenance submittals are not acceptable.

D. Refer to Division 01 and each individual Division 22 Section for additional submittal requirements.

E. Prepare maintenance manuals in accordance with Division 01. In addition to the requirements specified in Division 01, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

5. Facsimiles or photo copies are not allowed as submittals for operating and maintenance manuals. Submittals for operating and maintenance manuals must be on original manufacturer printed stock.

F. Prepare and submit Coordination Drawings as further described herein. The Engineer shall receive one copy of all coordination drawings supplied to the Owner as required in this specification. It is the responsibility of the Contractor to coordinate the work as outlined herein. Receipt by the Engineer of a copy of the coordination drawings is to verify conformance to the submittal requirements set forth in this specification section. It is not an admission by the Engineer as to the accuracy or completeness of the coordination proposed.

G. Coordination shall be drawn to a scale of ¼” = 1’0” or larger. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other
systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:

1. Planned piping layout, including valve and specialty locations and valve-stem movement. Include all piping including but not limited to Plumbing piping, HVAC piping, and fire protection piping. Include ceiling and wall-mounted access doors and panels required to provide access to valves and other operating devices.

2. Planned ductwork layout, including terminal units, dampers and specialty locations, with terminal unit and damper operator clearances. Include ceiling and wall-mounted access doors and panels required to provide access to dampers and other operating devices.

3. Clearances for installing and maintaining insulation.

4. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.

5. Equipment and accessory service connections and support details.


7. Fire-rated wall and floor penetrations.

8. Sizes and location of required concrete pads and bases.

9. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.

10. Floor plans, elevations, and details to indicate penetrations in floors, walls, ceilings and roofs, and their relationship to other penetrations and installations.

11. Clearances for installing and maintaining insulation.

12. Reflecting ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, access panels, special moldings, and other ceiling-mounted items.

**H.** Floor plans and sections of fan rooms and mechanical rooms; show layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

**I.** Prepare record documents in accordance with the requirements in Division 01. In addition to the requirements specified in Division 01, indicate the following installed conditions:

1. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Indicate actual inverts and horizontal locations of all underground piping.

2. Valve location diagrams, complete with valve tag chart. Refer to Division 220500 Section “Basic Plumbing Materials and Methods.”

3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.


5. Contract Modifications, actual equipment and materials installed.

6. Invert elevation of underfloor sanitary and storm piping.

**J.** Comply with each individual Division 22 Section for additional submittal requirements.

**K.** Electronic Media and Files:

1. Electronic media files of the contract drawings in AutoCAD or PDF format and copies of the specifications in PDF format may be requested.

2. Complete and return a signed “Electronic File Transmittal” form provided by Ross & Baruzzini upon request for electronic media,
3. Obtain approval from the appropriate Design Professional for use of their part of the documents if the information requested includes information prepared by other than Ross & Baruzzini.

4. The electronic contract documents may be used for preparation of shop drawings and record drawings only. The information may not be used in whole or in part for any other project.

5. The drawings prepared by Ross & Baruzzini for bidding purposes may not be used directly for raceway layout drawings or coordination drawings.

6. The use of these documents does not allow relief from the responsibility for coordination of work with other trades and verification of space available for the installation.

7. The information is provided to expedite the project with no guarantee by Ross & Baruzzini as to the accuracy or correctness of the information provided. Ross & Baruzzini accepts no responsibility or liability for the use of the provided information.

1.05 MATERIAL AND EQUIPMENT SELECTION

A. Product Options: The specification of each item of major mechanical equipment required for the project may include a list of manufacturers, with one “basis of design” manufacturer, type, and model identified by virtue of their listing in the equipment schedule on the Drawings. Where several manufacturers in addition to the “basis of design” manufacturer are listed in the specifications, it shall be understood that the words “or approved equal by” are implied to precede each of the other manufacturer’s names.

1. The manufacturers other than the “basis of design” may be furnished at the contractor’s option in lieu of the “basis of design” product, provided that the selected manufacturer’s product is equal in all material and functional respects. In addition to submittal requirements that may be specified in this section, submit a line-by-line written verification of the applicable specification section(s) identifying compliance with or variations from the specified features, materials, performance, capacities, weight, size, durability, energy consumption and efficiency, warranty, and visual impact (if exposed to view by other than maintenance persons). The burden of proof of manufacturer/product equality is on the contractor.

2. Where a product is not scheduled on the drawings and, therefore, where no “basis of design” is indicated, selection among all of the listed manufacturers and products is at the contractor’s option, subject to the requirements of the Contract Documents.

3. Products of manufacturers not listed in the Contract Documents are considered Substitutions and are not permitted, except as provided under the General and Supplementary Conditions and Division 01 Specifications. Full compliance with Division 01 section “Product Substitutions” is mandatory for acceptance of products or manufacturers not listed.

B. Listing of a manufacturer does not imply approval of that manufacturer’s standard product or products. Rather, listing of a manufacturer indicates only a general acceptance of that manufacturer’s name and reputation. Final approval is subject to full compliance with these Contract Documents.

C. Model numbers identified on the Drawings notwithstanding, all equipment must comply with the requirements of these Contract Documents. Do not assume that a manufacturer’s standard product is acceptable as is. For example, one or more custom modifications, custom colors or finishes, manufacturer’s options, and/or accessories may be required to meet the specified requirements.

D. Where drawings indicate sizes, profiles, connections, and dimensional requirements of material and equipment, these are based on the “basis of design” manufacturer, type and model indicated. In the event that equipment of power, dimensions, capacities, layout,
connections, and/or ratings differing from the “basis of design” are selected by the contractor and approved by the Owner's representative, any necessary adjustments are the contractor's responsibility. All connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, pipe and duct sizes, pipe and duct layout, and the like shall be adjusted by the contractor to suit the equipment provided. No additional costs will be approved for these changes. Should revisions to the design because of contractor's selection of manufacturer, type, or model other than the “basis of design” require additional review and/or redesign by an Architect or Engineer, the contractor shall reimburse the Owner for Owner's added professional fee expenses.

E. Where two or more materials are listed in the “Part 2 – Products” subsection of any Division 22 section, do not assume that the selection of materials is the contractor's option. Refer to “Part 3 – Execution” subsection of that same Division 22 section for an explanation of which specific material(s) shall be used for which specific application(s). For example, Part 2 may list several types and grades of piping, and Part 3 will describe which type and grade of pipe to use for a given application.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Protect stored on-site or installed absorptive materials from moisture damage. Materials directly exposed to moisture via precipitation, water leaks, or condensation shall be removed from the jobsite and replaced.

END OF SECTION 220100
SECTION 220500
BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

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

1.02 SUMMARY
A. This Section includes the following basic plumbing materials and methods to complement other Division 22 Sections:
   1. Materials and installation instructions common to plumbing systems.
   2. Dielectric fittings.
   3. Pipe sleeves.
   4. Escutcheons.
   5. Labeling and identifying plumbing systems and equipment.
   7. Painting and finishing of plumbing work.
   8. Concrete base construction requirements.
   9. Coordination with Structural work.
   10. Field-fabricated equipment supports.
   11. Selective Demolition.
   12. Cutting and patching.

1.03 DEFINITIONS
A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
F. The following abbreviations are used throughout Division 22 Specification Sections:
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. CR: Chlorosulfonated polyethylene synthetic rubber.
   4. EPDM: Ethylene propylene diene terpolymer rubber.
   5. NBR: Acrylonitrile-butadiene rubber.
   6. NP: Nylon plastic.
   7. PE: Polyethylene plastic.
   8. PVC: Polyvinyl chloride plastic.

1.04 QUALITY ASSURANCE
A. Welding: Qualify welding processes and operators for structural steel according to AWS D1.1 “Structural Welding Code – Steel.”
B. Welding: Qualify welding processes and operators for piping according to ASME “Boiler and Pressure Vessel Code,” Section IX, “Welding and Brazing Qualifications.”
2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.
3. Contactor shall retain all welding certificates on file and produce them for review upon request by the Owner and/or Owner’s representative.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor or roof, if stored thereupon.
C. Protect flanges, fittings, and piping specialties from moisture and dirt.
D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
E. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.06 SEQUENCING AND SCHEDULING
A. Coordinate plumbing equipment installation with other building components.
B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for plumbing installations.
C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
D. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
E. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
F. Coordinate requirements for access panels and doors if plumbing items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section “Access Doors and Panels.”
G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.
H. Coordinate connection of electrical services.

PART 2 - PRODUCTS
2.01 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Transition Couplings:
   a. Dresser Industries, Inc.
   b. or approved equal.

2. Dielectric Fittings:
   b. Grinnell Corp.; Grinnell Supply Sales Co.

3. Flexible Pipe Connectors:
   a. Flexicraft Industries, Inc.
   b. Hyspan Precision Products, Inc.
   c. Mason Industries, Inc.
   d. The Metraflex Company
   e. Proco Products, Inc.

4. Plumbing Sleeve Seals:
   a. Advanced Products and Systems, Inc./Innerlynx
   b. The Metraflex Company
   c. Thunderline/Link-Seal.

5. Identifying Devices and Labels:
   b. Brimar Industries, Inc.
   c. Kolbi Industries, Inc.
   d. Seton Name Plate Co.

2.02 PIPE AND PIPE FITTINGS
   A. Refer to individual Division 22 piping Sections for pipe and fitting materials and joining methods.

2.03 JOINING MATERIALS
   A. Refer to individual Division 22 piping Sections for joining materials.

2.04 DIELECTRIC FITTINGS
   A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
   B. Description: Combination of copper alloy and ferrous, threaded, solder, plain, and weld-neck end types and matching piping system materials.
   C. Insulating Material: Suitable for system fluid, pressure, and temperature.
   D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180°F (82°C).
   E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
   F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
   G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225°F (107°C).
   H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225°F (107°C).

2.05 FLEXIBLE PIPE CONNECTORS
   A. General: Fabricated from materials suitable for system fluid and that will provide equipment-pipe connections.
B. Flexible Pipe Connectors for Copper Piping: Corrugated bronze inner tubing covered with interwoven bronze wire braid. Include copper-tube ends, brazed to hose.

C. Flexible Pipe Connectors for Steel Piping: Corrugated stainless steel inner tubing covered with interwoven stainless-steel wire braid.

D. Performance Rating Requirements:
   1. Misalignment: Rated for ¾-inch (20-mm) permanent lateral offset.
   2. Length: As needed to allow offset rating above, but not less than 9-inches (230 mm).
   3. Design Working Pressure: 150 psig (1035 kPa) at 300°F (149°C).

E. Schedule of End Connections:
   1. 2-Inch NPS (DN50) and Smaller, Copper Pipe: Copper tube end connections suitable for soldering to adjacent piping; except that brazed end connections are required for refrigerant service.
   2. 2-Inch NPS (DN50) and Smaller, Steel Pipe: Threaded-end carbon steel nipples welded to hose; except that stainless-steel ends are required for natural gas service or where mated to stainless steel piping.
   3. 2½-Inch NPS (DN65) and Larger: Carbon-steel flanged end connections welded to hose and drilled to meet ANSI Class 150; except that stainless-steel flanged end connections are required for natural gas service or where mated to stainless steel piping.

F. Flexible pipe connectors specified herein are for use at the piping connection to a piece of plumbing equipment, including but not limited to pumps. These are not acceptable for use where "expansion joints" or "pipe expansion fittings" are called out. Refer to Division 22 Section "Pipe Expansion Fittings" for pipe expansion joints or pipe expansion fittings.

2.06 MECHANICAL SLEEVE SEALS
A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

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: Stainless steel. Include two for each sealing element.

D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.07 PIPE SLEEVES
A. The following sleeve materials are for wall, floor, slab, and roof penetrations.

B. Steel Pipe: ASTM A53, Type E, Grade A, 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 setscrews.

E. PE: Manufactured, reusable, tapered, cup shaped, smooth outer surface, with nailing flange for attaching to wooden forms.

F. Contractor’s Option: Pre-engineered, UL-listed fire-resistance rated and watertight cast-in-place floor sleeving systems meeting the following specifications will be acceptable in lieu of traditional floor sleeves with field-installed firestop, at contractor’s option.
   1. Description: Cast-in-place, factory-assembled, one-piece watertight firestop device for use in concrete floors formed with wood and/or steel decking to protect
penetrating objects from expansion and contraction of concrete, thermal and seismic movement, and the passage of air, smoke, fire, and hot gasses.

2. Manufacturer: Subject to compliance with requirements, provide Hydroflame™ sleeving system by Hubbard Enterprises / Holdrite; or approved equal.

3. Include an outer sleeve lined with an intumescent strip; and a radial extended flange attached to one end of the sleeve for fastening to concrete formwork; or wide outside wings attached to one end of the sleeve for fastening to metal deck concrete formwork and span deck corrugations.

4. Include a waterstop gasket and mid-body seal consisting of one to three concentric raised rings for embedment and sealing to the concrete slab. For applications involving a corrugated deck, also include a cone attached to the base for extending the device through the metal deck.

5. Product shall provide a two-hour fire-resistance rated assembly when tested according to ASTM E814 or ANSI/UL 1479.

2.08 ESCUTCHEONS

A. General: 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 and polished chrome-plated finish.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw and polished chrome-plated finish.

E. One-Piece, Stamped-Steel Type: With spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.09 IDENTIFYING DEVICES AND LABELS

A. General: Manufacturer’s standard products of categories and types required for each application as referenced in other Division 22 Sections. If more than one type is specified for application, selection is installer’s option, but provide one selection for each product category.

B. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

C. Equipment Nameplates: Metal nameplate with operational data engraved or stamped; permanently fastened to equipment; furnished and factory-installed by original equipment manufacturer.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.

2. Location: Accessible and visible location.


E. Engraved Plastic-Laminate Signs: ASTM D709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated.

1. Fabricate in sizes required for message.
2. Engraved with engraver’s standard letter style, of sizes and with wording to match equipment identification.
3. Punch for mechanical fastening.
4. Thickness: 1/16-inch (1.6 mm), for units up to 20 sq. in. (130 sq. cm) or 8 inches (200 mm) long; 1/8-inch (3.2 mm) for larger units.
5. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.

F. Valve Tags: Photo-anodized barcode tags with ¼-inch (6-mm) letters and numbers. Include 5/32-inch (4-mm) hole for fastener.
1. Material: 0.032-inch (0.8-mm) thick anodized aluminum.
2. Color: Silver background with black characters.
3. Printed Nomenclature: Piping system abbreviation and sequenced number; e.g., HW-23 for domestic hot water supply valve #23; HWR-12 for domestic hot water return valve #12.
4. Barcode: Two-dimensional Data Matrix ECC 200 barcode symbology. Prior to manufacture, obtain valve tag information from owner’s property manager for encoding into the barcode. Include valve number, piping system, system abbreviation, location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

G. Valve Tag Fasteners: Brass, wire-link chain or stainless steel beaded chain.

H. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in plumbing identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of plumbing systems and equipment.
1. Multiple Systems: If multiple systems of same generic name are indicated, provide identification that indicates individual system number and service such as “Domestic Water Heater DWH1,” “Hot Water Recirculation Pump HWRP1,” or “Standpipe F12.”

2.10 CONCRETE AND GROUT
A. Concrete: For all minor concrete work required for plumbing installations, such as concrete equipment bases and supports, refer to Division 03 Sections for specification of cast-in-place concrete and reinforcing materials, whose requirements apply to the work of Division 22 as if fully reproduced herein.
B. Concrete: For all minor concrete work required for plumbing installations, such as concrete equipment bases and supports, provide Quikrete® Commercial Grade FastSet™ Concrete #1004-51 prepackaged concrete mix, or approved equal. Mix, place, and cure in accordance with manufacturer’s written instructions.
1. Reinforcing: ASTM A615 Grade 60 deformed bars and ASTM A185 welded wire fabric.
C. Non-shrink, Nonmetallic Grout: ASTM C1107, Grade B.
2. Design Mix: 5000-psig (34.5-MPa), 28-day compressive strength.

2.11 PAINTING AND FINISHING
A. For all painting and finishing work required for plumbing installations, as described in Part 3 of this Section and/or on the Drawings, refer to Division 09 Sections for specification of paint and finishing materials, whose requirements apply to the work of Division 22 as if fully reproduced herein.
B. Master Painters Institute, Inc. (MPI) Standards: Provide paint and paint products that comply with MPI standards indicated and that are listed in its “MPI Approved Products List.”

C. Material Compatibility: Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

D. Colors: As directed by Owner’s representative. Each pipe shall be painted a designated color according to service.

PART 3 - EXECUTION

3.01 GENERAL PLUMBING INSTALLATION REQUIREMENTS

A. Verify all dimensions by field measurements.

B. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

C. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.

D. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

E. Install plumbing equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

F. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.02 PIPE-PENETRATION INSTALLATION REQUIREMENTS

A. Install escutcheons for new piping penetrations of walls, ceilings, and floors according to the following:

1. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
2. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
3. Insulated Piping: One-piece, stamped-steel type with spring clips.
4. Uninsulated Piping in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
5. Uninsulated Piping in Unfinished Spaces: One-piece, cast-brass type.
6. Uninsulated Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

B. Install escutcheons for existing piping penetrations of new walls, ceilings, and floors. Match type, material, and finish as specified for new piping, except that split-casting or split-plate type will be accepted in lieu of one-piece.

C. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.

D. Cut sleeves to length for mounting flush with both surfaces. Exception: Extend sleeves installed in floors of mechanical/plumbing equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

E. Fire-Resistance Rated, Cast-in-Place Sleeve Installation: Select sleeve size based on size and type of pipe and thickness of the floor. Position and secure sleeve to concrete form
using nails or staples. Place concrete, and finish even with top of sleeve. Install in complete and strict accordance with manufacturer’s UL-listed installation instructions.

F. Build sleeves into new walls and slabs as work progresses.

G. Install sleeves large enough to provide ¼-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   1. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS (DN150).
   2. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section “Flashing and Sheet Metal” for flashing.
   3. Seal space outside of sleeve fittings with nonshrink, nonmetallic grout.

H. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Refer to Division 07 Section “Joint Sealants” for materials. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.

I. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
   2. Install cast-iron “wall pipes” for sleeves 6 inches (150 mm) in diameter and larger.
   3. Assemble and install mechanical sleeve seals according to manufacturer’s written instructions. Tighten bolts that cause rubber-sealing elements to expand and make watertight seal.

J. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron “wall pipes” for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals. Assemble and install mechanical sleeve seals according to manufacturer’s written instructions. Tighten bolts that cause rubber-sealing elements to expand and make watertight seal.

K. Sleeves are not required for core-drilled holes.

L. Permanent sleeves are not required for holes formed by PE removable sleeves.

M. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials. Refer to Division 07 Section “Penetration Firestopping” for materials.

3.03 EQUIPMENT INSTALLATION REQUIREMENTS

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Division 22 and Division 26 for rough-in requirements.

C. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.

D. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.

E. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

F. Positive attachment and anchorage of all equipment to the structure or floor is required. Do not rely on friction or gravity as a means of attachment.

G. 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.
H. Install equipment giving right of way to piping installed at required slope.

I. Install flexible pipe connectors at the following locations. Install on equipment side of shutoff valves.
   1. Inlet and outlet of each pump.
   2. Where indicated elsewhere in these specifications.

J. Support for Suspended Equipment: As specified in Division 22 Section “Hangers and Supports.”

### 3.04 LABELING AND IDENTIFYING

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow. Use plastic markers, with application systems. Install on insulation segment if required for hot, uninsulated piping.

B. Locate pipe markers as follows if piping is exposed in finished spaces, machine rooms, and accessible maintenance spaces, such as shafts, tunnels, plenums, and exterior nonconcealed locations:
   1. Near each valve and control device.
   2. Near each branch, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, if flow pattern is not obvious.
   3. Near locations where pipes pass through walls, floors, ceilings, or enter nonaccessible 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 of 50-foot (15-m) intervals along each run. Reduce intervals to 25 feet (7.5 m) in congested areas of piping and equipment.
   7. On piping above removable acoustical ceilings, except omit intermediate spaced markers.

C. Install continuous plastic underground warning tapes during back filling of trenches for underground piping. Locate 6 to 8 inches (150 to 200 mm) below finished grade, directly over piping. Refer to Division 31 Section “Earth Moving” for warning-tape materials and devices and their installation.

D. Equipment: Install engraved plastic-laminate sign on or near each major item of plumbing equipment.
   1. Lettering Size: Minimum ¼-inch- (6.4-mm-) high lettering for name of unit if viewing distance is less than 24 inches (610 mm), ½-inch- (12.7-mm-) high lettering for distances up to 72 inches (1800 mm), and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
   2. Text of Signs: Provide name of identified unit. Include text to distinguish between multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

E. Adjusting: Relocate identifying devices as necessary for unobstructed view in finished construction.

F. Install valve tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, faucets, and similar roughing-in connections of end-use fixtures and units.

### 3.05 PAINTING AND FINISHING

A. For all painting and finishing work required for plumbing installations, refer to Division 09 Sections for application requirements.
B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45°F. Maintain containers in clean condition, free of foreign materials and residue. Remove rags and waste from storage areas daily.

C. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50°F and 95°F. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5°F above the dew point; or to damp or wet surfaces.

D. Examine substrates and conditions for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected. Application of coating indicates acceptance of surfaces and conditions.

G. Comply with manufacturer's written instructions and recommendations in “Master Painters Institute (MPI) Manual” applicable to substrates indicated.

H. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints. Remove surface oxidation, loose mill scale, and shop primer, if any. Clean field welds, bolted connections, and abraded areas of shop paint.

I. Apply paints according to manufacturer’s written instructions and to recommendations in “MPI Manual.” Use applicators and techniques suited for paint and substrate indicated. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

J. 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.

K. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

L. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

M. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

N. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

O. Steel Substrates: Primer, alkyd, anti-corrosive, for metal, MPI #79; plus topcoat of latex, interior, semi-gloss, MPI #54.

P. Galvanized-Metal Substrates: Primer, galvanized, water based, MPI #134; plus topcoat of latex, interior, semi-gloss, MPI #54.

Q. Aluminum (Not Anodized or Otherwise Coated) Substrates: Primer, quick dry, for aluminum, MPI #95; plus topcoat of latex, interior, semi-gloss, MPI #54.

R. ASJ Insulation-Covering Substrates: Including pipe and duct coverings. Primer sealer, latex, interior, MPI #50; plus topcoat of latex, interior, semi-gloss, MPI #54.

S. Primers specified above may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

3.06 CONCRETE BASES

A. Anchor equipment to concrete base according to equipment manufacturer’s written instructions and according to Division 20 Section “Seismic Protection.”
B. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.

C. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.

D. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

E. Place and secure anchorage devices. Use supported equipment manufacturer’s setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

F. Install anchor bolts to elevations required for proper attachment to supported equipment.

G. Install anchor bolts according to anchor-bolt manufacturer’s written instructions.

H. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03.

3.07 COORDINATION WITH STRUCTURAL WORK

A. Concrete: Do not embed pipes, wires, tube, boxes, ducts or other cavity-creating elements in concrete work unless shown on or permitted by the structural drawings. Openings through concrete not shown on the structural drawings are subject to approval by the structural engineer of record. See coordination drawing requirements under Submittals.

B. Roof Deck: Do not place loads on, or hang any loads whatsoever from roof deck, unless shown on structural drawings, including, but not limited to, hangers for pipes, ducts, equipment, etc. Trade contractor installing such loads shall provide sub-framing connected to steel frame.

1. Do not exceed capacity of roof deck as a working platform. Submit all proposed construction loads to deck supplier for approval.
2. Openings in roof deck not shown on structural drawings, such as openings required for stacks, pipes, ducts, plumbing vents, etc., shall be cut and reinforced by trade requiring opening.

C. Supported Slab: Do not suspend loads exceeding 500 pounds within any 100 square feet of contiguous area from concrete supported slab. Suspend such loads from structural steel only. Any “sub-framing” required is responsibility of Contractor or sub-contractor installing material requiring support.

1. Openings in concrete floor slabs not shown on structural drawings, such as openings required for stacks, pipes, ducts, plumbing vents, etc., shall be the responsibility of the trade requiring openings. Form blockouts in the slab, reinforcing deck, and cut openings after concrete has reached specified strength.
2. Where openings larger than 12-inches are required but not shown on structural drawings, secure written approval from Architect/Engineer prior to cutting deck.

3.08 ERECTION OF SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.


3.09 SELECTIVE DEMOLITION

A. Disconnect, demolish, and remove plumbing work as indicated on the Drawings, and as required for installation of new work shown. Coordinate with Division 26 for disconnection of power to electrically-powered equipment prior to demolition.

B. Remove accessible work in its entirety. Repair cut surfaces to match adjacent surfaces. Abandon in place embedded or buried work, unless noted otherwise.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.

3. Equipment to Be Removed: Disconnect and cap services and remove equipment.

C. Removal: Unless otherwise indicated, remove demolished pipe, and equipment from the Project site. Handle and dispose of in accordance with National, State, and Local regulations.
   1. Relocation: Remove, store, clean, reinstall, reconnect, and make operational all work indicated for relocation.
   2. Salvage: Remove and deliver to Owner all work indicated for salvage.

D. Refer to Division 01 Sections “Selective Demolition” and/or “Selective Structure Demolition” for additional requirements.

E. For selective demolition of any appliance or piece of equipment containing a CFC, HCFC, or HFC refrigerant: Prior to demolition, refrigerant shall be evacuated and captured in full compliance with the Clean Air Act; using only technicians with the proper refrigerant license as according to law, stored in approved containers, and shipped to a licensed refrigerant recycling facility all as required by the United States Environmental Protection Agency.

3.10 CUTTING AND PATCHING

A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay. Perform cutting and patching in accordance with the following:

B. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

C. Perform cutting, fitting, and patching of plumbing equipment and materials required to:
   1. Uncover Work to provide for installation of ill-timed Work.
   2. Remove and replace defective Work.
   3. Remove and replace Work not conforming to requirements of the Contract Documents.
   4. Install equipment and materials in existing structures.

D. Cut, remove and legally dispose of selected plumbing equipment, components, and materials as indicated, including but not limited to removal of plumbing piping, pumps, and other plumbing items made obsolete by the new Work.

E. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for plumbing installations. Perform cutting by skilled mechanics of trades involved.

F. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

G. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

H. Repair cut surfaces to match adjacent installations.

I. Repair any building insulation or building fireproofing materials, whether new or existing, that are removed or scraped away in order to make a plumbing installation, so as to maintain an equivalent insulation or fire rating as existed without said plumbing installation.

J. Refer to Division 01 Sections “Execution” and/or “Cutting and Patching” for additional requirements.

3.11 GROUTING

A. Install nonmetallic, non-shrink, grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Mix grout according to manufacturer’s written instructions. Clean surfaces that will come into contact with grout.
C. Provide forms as required for placement of grout.
D. Place grout, completely filling equipment bases. Avoid air entrapment during placing of grout. Place grout on concrete bases to provide smooth bearing surface for equipment. Place grout around anchors.
E. Cure placed grout according to manufacturer’s written instructions.

END OF SECTION 220500
SECTIOΝ 220523
VALVES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 220100 “Basic Plumbing Requirements” and Section 220500 “Basic Plumbing Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.02 SUMMARY
A. This Section includes the following general-duty valves common to Division 22 plumbing piping systems:
   1. Ball valves.
   2. Butterfly valves.
   3. Check valves.
B. Related Sections include the following:
   1. Division 22 Section “Plumbing Identification” for valve tags and charts.
   2. Division 22 Section “Basic Plumbing Materials and Methods” for valve tags and charts.
   3. Division 22 piping Sections for specialty valves applicable to those Sections only.
   4. Valves - natural gas service, medical gases, fire protection, and other specialty services are specified in their respective piping Section.

1.03 DEFINITIONS
A. The following are standard abbreviations for valves used in this Section:
   1. CWP: Cold working pressure (formerly WOG – Water, Oil, Gas working pressure).
   2. EPDM: Ethylene-propylene-diene terpolymer rubber.
   3. IBBM: Iron body, bronze-mounted.
   4. PTFE: Polytetrafluoroethylene plastic.
   5. SWP: Steam working pressure.
   6. TFE: Tetrafluoroethylene plastic.
   8. Class 150: Minimum 150-psig SWP and minimum 300-psig CWP ratings.

1.04 SUBMITTALS
A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
B. Maintenance Data: For each type of valve, to include in the operation and maintenance manual specified in Division 01. Include detailed manufacturer’s instructions on adjusting, servicing, disassembling, and repairing.

1.05 QUALITY ASSURANCE
A. ASME Compliance: ASME B31.9 for building services piping valves.
B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
C. NSF Compliance: NSF 61 for valve materials for potable-water service in compliance with Public Law #111-380.
D. MSS Compliance: Comply with the various MSS Standard Practice documents referenced herein.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   4. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. General: Subject to compliance with requirements, provide gate valves, globe valves, and swing check valves by one of the following:
   1. Milwaukee Valve Company.
   2. NIBCO Inc.

B. Ball Valves: Subject to compliance with requirements, provide ball valves by one of the following:
   1. Any of the manufacturers listed under the “General” subheading above.

C. Swing, piston and Wafer Check Valves: Subject to compliance with requirements, provide butterfly-style dual-plate wafer check valves, piston-style lift-disc, and swing check valves by one of the following: Any of the manufacturers listed under the “General” subheading above.
   1. Nibco
   2. Watts
   3. Apollo

2.02 VALVES, COMMON REQUIREMENTS
A. General: Refer to Part 3 “Valve Applications Schedule” Article for application schedule of valves, end connections, and actuator types.

B. Valve Sizes: Same as upstream pipe size, unless otherwise indicated.

C. Valve Bypass and Drain Connections: MSS SP-45.

D. Class Substitution: 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.

E. For piping systems required to be insulated, valve stems shall be extended to accommodate insulation. Refer to other Division 22 Sections for piping systems required to be insulated.

F. NSF Compliance: NSF 61 for valve materials for potable-water service in compliance with Public Law #111-380.

2.03 BALL VALVES
A. Liquid Service, Size NPS 2-1/2 and smaller:
   1. General: Valve shall conform to MSS SP-110.
5. Ball: Type 316 stainless steel, full port.
7. Seat/Packing: PTFE or TFE.
9. Handle: Vinyl-covered steel lever with memory stop; and zinc-plated steel nut.

2.04 CHECK VALVES
A. Bronze Swing Check Valve, NPS 2 and smaller: Valve shall conform to MSS SP-80.
   1. Minimum pressure rating: Class 150.
   4. Disc and seat: Renewable; ASTM B62 bronze with bronze-alloy hinge pin.
   5. Hardware: Bronze or bronze alloy.

PART 3 - EXECUTION
3.01 EXAMINATION
A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
D. Examine threads on valve and mating pipe for form and cleanliness.
E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
F. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION
A. Install valves as indicated, according to manufacturer’s written instructions.
B. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
C. Install isolation valves at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
D. Locate valves for easy access and provide separate support where necessary.
E. Install valves in horizontal piping with stem at or above center of pipe.
F. Any valve that represents a termination or the end of a run (e.g., blowdown or drain valve, hose-end valve, etc.) shall be fitted with a permanent but removable cap, plug, or blind flange matching the valve construction, to minimize risk in the event the valve is accidentally opened under pressure.
G. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level, or vertical with upward flow.
3.03 JOINT CONSTRUCTION

A. Refer to Division 22 Section “Basic Plumbing Materials and Methods” for basic piping joint construction.

B. Threaded Connections: Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.
   1. Align threads at point of assembly.
   2. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.
   3. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.04 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.

3.05 Valve Applications Schedule

A. General: Refer to piping Sections and Drawings for specific valve applications. If no specific valve type is indicated, use the valve types indicated in the following schedules.

B. Domestic Water Piping: Choices are contractor’s option unless a specific type of valve is specifically called out by name on the Drawings.
   1. For shutoff duty, NPS 2 and smaller, use ball valves.
   2. For pump discharge protection, NPS 2 and smaller, use swing check valves.
   3. For one-way flow control other than at pump discharge, use swing check valves in all sizes.

END OF SECTION 220523
PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 220100 “Basic Plumbing Requirements” and Section 220500 “Basic Plumbing Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.02 SUMMARY
A. This Section includes hangers and supports for mechanical system piping and equipment, including but not limited to the following:
1. Metal pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Fastener systems.

1.03 DEFINITIONS
A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
B. Terminology: As defined in MSS SP-90, “Guidelines on Terminology for Pipe Hangers and Supports.”

1.04 PERFORMANCE REQUIREMENTS
A. If contractor elects to apply channel support systems and/or heavy-duty steel trapezes to support multiple pipes, in lieu of individual supports, then contractor is responsible for design of same capable of supporting combined weight of supported systems, system contents, and test water.
   1. Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
C. Do not suspend pipe hangers and supports from roof deck. Suspend such loads from structural steel only, and provide structural steel sub-framing as required.
D. Do not suspend piping loads exceeding 500 pounds within any 100 square feet of contiguous area from supported concrete floor slabs. Suspend such loads from structural members only, and provide structural steel sub-framing as required.
E. 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.

1.05 SUBMITTALS
A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated. Include:
   1. Metal pipe hangers and supports.
   2. Thermal-hanger shield inserts.
   3. Fastener systems.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Manufactured Pipe Hangers:
a. Anvil International, Inc.
b. Cooper B-Line, Inc.
c. Carpenter & Patterson, Inc.
d. Erico International Corp.
e. PHD Manufacturing, Inc.
f. Tolco division of Cooper B-Line, Inc.

2. Thermal-Hanger Shield Inserts:
   a. Carpenter & Paterson, Inc.
   b. Erico International Corp.
   c. PHS Industries, Inc.
   d. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

3. Powder-Actuated Fastener Systems:
   a. Hilti, Inc.
   b. ITW Ramset/Red Head.

2.02 METAL PIPE HANGERS AND SUPPORTS
   A. Application: Refer to “Hanger and Support Applications” Article in Part 3 for where to use specific hanger and support types.
   B. Carbon-Steel Pipe Hangers and Supports:
      1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
      2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
      3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
      4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
      5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel unless noted otherwise.

2.03 THERMAL-HANGER SHIELD INSERTS
   A. Insulation-Insert Material for Piping Below Ambient Temperature: ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
   B. Insulation-Insert Material for Piping At or Above Ambient Temperature: Water-repellent treated, ASTM C553, Type I calcium silicate with 100-psig ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
   C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
   D. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.

2.04 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.

2.05 MISCELLANEOUS MATERIALS
   A. Structural and Miscellaneous Steel: As specified in Division 22 Section “Basic Plumbing Materials and Methods.”
   B. Grout: As specified in Division 22 Section “Basic Plumbing Materials and Methods.”
PART 3 - EXECUTION

3.01 HANGER AND SUPPORT SCHEDULE OF APPLICATIONS

A. Comply with MSS SP-69 for pipe hanger and trapeze selections and applications that are not specified in this Section.

B. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use copper-plated pipe hangers and copper or stainless-steel attachments, or use nonmetallic coatings on attachments for electrolytic protection, where hangers are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports for the first three hangers/supports or the first 50-feet adjacent to Pumps: Use spring hangers and supports. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports shall include the following types:
   1. Horizontal (MSS Type 54): Mounted horizontally.
   2. Vertical (MSS Type 55): Mounted vertically.
   3. Exception: Spring hangers are not required adjacent to inline pumps that are smaller than 5-horsepower. Use other types of hangers and supports as listed for service below.

G. Horizontal-Piping Hangers and Supports for individual pipe runs less than 20 feet long and all piping 2-inch diameter or smaller, regardless of length: Unless otherwise indicated, choose among the following types:
   1. Adjustable Steel Clevis Hangers (MSS Type 1).
   2. Yoke-Type Pipe Clamps (MSS Type 2): For pipes NPS 4 and larger.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3).
   4. Steel Pipe Clamps (MSS Type 4).

H. Horizontal-Piping Hangers and Supports for individual uninsulated pipe runs of any size or length: Unless otherwise indicated, choose among the following types:
   1. Adjustable Steel Clevis Hangers (MSS Type 1).
   2. Yoke-Type Pipe Clamps (MSS Type 2): For pipes NPS 4 and larger.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3).
   4. Steel Pipe Clamps (MSS Type 4).
   5. Adjustable Steel Band Hangers (MSS Type 7): For pipes up to NPS 2 only.
   6. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For pipes up to NPS 2 only.
   7. U-Bolts (MSS Type 24).

I. Vertical-Piping Hangers and Supports for individual pipe runs less than 20 feet long and all piping 2-inch diameter or smaller, regardless of length: Unless otherwise indicated, choose among the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8).
   2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): Where longer ends are required.

J. Hanger-Rod Attachments: Unless otherwise indicated, choose among the following types:
   1. Steel Turnbuckles (MSS Type 13).
   2. Steel Clevises (MSS Type 14).
   3. Malleable-Iron Sockets (MSS Type 16).
   4. Steel Weldless Eye Nuts (MSS Type 17).
K. Building Attachments: Unless otherwise indicated, choose among the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to concrete ceiling.
2. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
3. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams.
4. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
5. 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.
6. Side-Beam Brackets (MSS Type 34): For sides of steel beams.
7. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

3.02 HANGER AND SUPPORT MAXIMUM SPACING AND MINIMUM ROD SIZE

A. Install hangers and supports with the following maximum spacing and minimum rod sizes.

B. Flanged, Threaded, or Welded Steel Piping for Fuel Gas piping systems:
   1. NPS ½: Maximum span, 5 feet; minimum rod size, 3/8-inch.
   2. NPS ¾: Maximum span, 7 feet; minimum rod size, 3/8-inch.
   3. NPS 1: Maximum span, 8 feet; minimum rod size, 3/8-inch.

C. Drawn-Temper Copper Piping for any liquid-service piping systems:
   1. NPS ½: Maximum span, 4 feet; minimum rod size, 3/8-inch.
   2. NPS ¾: Maximum span, 5 feet; minimum rod size, 3/8-inch.
   3. NPS 1: Maximum span, 6 feet; minimum rod size, 3/8-inch.
   4. NPS 1¼: Maximum span, 6 feet; minimum rod size, 3/8-inch.
   5. NPS 1½: Maximum span, 8 feet; minimum rod size, 3/8-inch.
   6. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8-inch.

D. Cast Iron and/or Ductile Iron Piping: Install hangers at the same maximum spacing and with the same minimum rod sizes as for Steel Piping for hydronic system service, except that maximum spacing shall not exceed 12 feet and smallest rod size allowed is ½-inch.
   1. Vertical piping: Shall be supported at each stack base and at each floor. Free standing vertical pipe should be adequately staked or braced during construction to maintain alignment.
   2. Horizontal piping: Shall be supported within 18-inches of the coupling joint at maximum 10 foot intervals for 10 foot pipe lengths and at maximum 5 foot intervals for 5 foot pipe lengths. Support or hangers should be properly placed to maintain alignment and grade with provision made to prevent shear. Large diameter pipe should be braced at changes of direction to prevent horizontal movement.

E. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

F. Rod diameters may be reduced one size for double-rod hangers, with 3/8-inch (10 mm) minimum rods.

G. Hanger and support spacing for piping and tubing not listed above shall be according to MSS SP-69 and piping manufacturer’s written instructions.

3.03 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. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
D. 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.
E. Install lateral bracing with pipe hangers and supports to prevent swaying.
F. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
G. 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.
H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2½ (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
I. Repair any building insulation or building fireproofing materials, whether new or existing, that are removed or scraped away in order to attach hangers and supports, so as to maintain an equivalent insulation or fire rating as existed without said hanger or support attachment.
J. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4-inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer’s operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer’s written instructions.

3.04 PROTECTION OF INSULATED PIPING:
A. Attach clamps and spacers to piping.
   1. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   2. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
B. Do not exceed pipe stress limits according to ASME B31.9.
C. Piping Operating above Ambient Air Temperature: Clevis- and clamp-type supports shall project through insulation, with pipe support making direct contact with pipe and with insulation applied in a manner that encapsulates the clevis or clamp. For piping on roller-type supports, install MSS SP-58, Type 39 protection saddles, and fill interior voids with insulation that matches adjoining insulation.
   1. Contractor’s Option: In lieu of the above paragraph, contractor has the option of complying with the same specifications as for “Piping Operating below Ambient Air Temperature” in the following paragraphs.
D. Piping Operating below Ambient Air Temperature: Clevis- and clamp-type supports shall be sized for the outside diameter of the insulation including jacket. Install MSS SP-58, Type 40 protective metal shields. Shields shall span an arc of 180 degrees.
   1. Metal Shield Dimensions for Pipe: Not less than the following:
      a. NPS ¼ to NPS 3½: 12-inches long and 0.048-inch thick.
3.05 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 1½-inches (40 mm).

END OF SECTION 220529
PART 1 - GENERAL

1. RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   B. Section 22 01 00 “Basic Plumbing Requirements,” and Section 22 0500 “Basic Plumbing Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.2 SUMMARY
   A. This Section includes plumbing insulation for, equipment, piping, and other installations, including the following:
      1. Insulation Materials:
         a. Flexible elastomeric.
         b. Mineral fiber.
      2. Tapes.
      3. Securements.
      4. Protective shielding guards.
   B. Related Sections include the following:

1.3 DEFINITIONS
   A. ASJ: All-service jacket.
   B. FSK: Foil, scrim, kraft paper.
   C. SSL: Self-sealing lap.
   D. Thermal Resistivity: “R-values” represent the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1-inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between two exposed faces required to cause one BTU to flow through one square foot of material, in one hour, at a given mean temperature.
   E. Refer to Division 22 Section “Basic Plumbing Materials and Methods” for definitions of finished, interior, exterior, exposed, and concealed locations.

1.4 SUBMITTALS
   A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1.5 QUALITY ASSURANCE
   A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
   B. Fire-Test-Response Characteristics: Insulation and related materials shall have flame-spread index of 25 or less, and smoke-developed index of 50 or less, as determined by testing identical products per ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1.6 DELIVERY, Storage, AND HANDLING
   A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.
1.7 COORDINATION
A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports."
B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING
A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
   1. Flexible Elastomeric Insulation:
      a. Aeroflex USA Inc.; Aerocel.
      b. Armacell LLC; AP Armaflex.
      c. K-Flex USA; Insul-Lock® Seam-Seal.
   2. Mineral-Fiber, Preformed Pipe Insulation:
      b. Knauf Insulation.
      c. Owens Corning.
   3. Tapes: Same as insulation manufacturer, or
      a. Avery Dennison Corporation, Specialty Tapes Division.
      b. Compac Corp.
      c. Ideal Tape Co., Inc., an American Biltrite Company.
      d. Venture Tape.
   4. Insulation Pins and Hangers: Same as insulation manufacturer, or
      a. AGM Industries, Inc.
      b. GEMCO.
      c. Midwest Fasteners, Inc.

2.2 INSULATION MATERIALS
A. Refer to Schedule in Part 3 for requirements about where insulating materials shall be applied.
B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.
D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type I for tubular materials and Type II for sheet materials.

1. Thermal Conductivity: 0.27 average maximum at 100°F mean temperature.
3. Low-emitting (VOC) adhesive.

G. Mineral-Fiber, Prefomed Pipe Insulation: Type I, 850°F; mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547, Type I, Grade A, with factory-applied jacket.

1. Thermal Conductivity: 0.26 average maximum at 75°F mean temperature.
3. Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
4. Low emitting (VOC) adhesive.

2.3 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136 and UL listed.

1. Width: 3-inches (75 mm).
2. Thickness: 11.5 mils (0.29 mm).
3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.4 SECUREMENTS

A. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1½-inch (38-mm) galvanized carbon-steel washer.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Baseplate shall be perforated, galvanized carbon-steel sheet, 0.030-inch (0.76 mm) thick by 2-inches (50 mm) square. Spindle shall be copper, aluminum, or stainless steel, fully annealed, 0.106-inch (2.6-mm) diameter shank, length to suit depth of insulation indicated. Adhesive shall be as recommended by hanger manufacturer; with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Self-Sticking-Base Insulation Hangers: Adhesive-backed base with a peel-off protective cover; and 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. Baseplate shall be galvanized carbon-steel sheet, 0.030-inch (0.76 mm) thick by 2-inches (50 mm) square. Spindle shall be copper, aluminum, or stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch (0.41-mm) thick, aluminum or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1½-inches (38 mm) in diameter. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
2.5 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers.
   1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

   2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain plumbing. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
   1. Verify that systems and equipment to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 COMMON INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

M. 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.

N. At the following locations, omit jacket and provide a separate cutaway removable segment of insulation clearly labeled “Access.” For below-ambient services, provide a design that allows access but maintains vapor barrier.
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.
   5. Handholes.
   6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations:
   1. Install pipe insulation continuously through pipe penetrations of fire-rated walls and partitions.
   2. Firestopping and fire-resistive joint sealers are specified in Division 07 Section “Penetration Firestopping.”

C. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies according to Division 07 Section “Penetration Firestopping.”

3.5 PIPE INSULATION INSTALLATION

A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. If furnished in half sections, orient longitudinal joints at 3 and 9 o'clock positions on the pipe.
   2. All insulation shall be tightly butted and free of voids and gaps at all joints.
   3. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   4. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6-inches (150 mm) o.c.
   5. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant. Vapor barrier must be continuous.
C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
3. Cut sectional pipe insulation to fit. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

D. Insulation Installation on Valves, Strainers, Unions, and Specials:
1. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation over valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
4. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
5. Insulate unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
6. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
7. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
8. Stencil or label the outside insulation jacket of each union with the word “UNION.” Match size and color of pipe labels.

E. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

F. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2-inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

G. Special Requirements for Flexible Elastomeric Insulation Installation: Seal all transverse seams, longitudinal seams, end joints, and section joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.7 PIPING INSULATION SCHEDULE, GENERAL

A. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Fire-suppression piping.
   2. Drainage (sanitary/waste) piping located in crawl spaces.
   4. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

B. Hot Surfaces: For piping services denoted all piping surfaces including but not limited to pipe, flanges, fittings, valves of every kind, strainers, unions, and other appurtenances shall be insulated to avoid potential for personnel injury via contact with hot surface.

C. Cold Surfaces: For piping surfaces operating below surrounding ambient temperature, all piping surfaces including but not limited to pipe, flanges, fittings, valves of every kind, strainers, unions, and other appurtenances shall be insulated and shall include uninterrupted vapor barrier to avoid potential condensation.

3.8 PIPE INSULATION SCHEDULE, INDOORS

A. Domestic Cold Water:
   1. Insulation shall be any of the following:
      b. Mineral-Fiber, Preformed Pipe, Type I: 1-inch thick.

B. Domestic Hot-Water Supply and Return, 140°F and below:
   1. NPS 1¼ and Smaller: Insulation shall be Mineral-Fiber, Preformed Pipe, Type I, 1-inch thick.
   2. NPS 1½ and Larger: Insulation shall be Mineral-Fiber, Preformed Pipe, Type I, 1-1/2 inches thick.

C. Domestic Water Branch Piping to Fixtures within Walls/Chases (Hot and Cold; Non-Recirculated):
   1. NPS 2 and Smaller: Insulation shall be Mineral-Fiber, Preformed Pipe, Type I, 1/2 -inch thick or flexible elastomeric, 1/2 inch thick.

END OF SECTION 22 0700
SECTION 221116
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   B. Section 20 0800 “Seismic Protection,” Section 22 0100 “Basic Plumbing Requirements,” and Section 22 0500 “Basic Plumbing Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.02 SUMMARY
   A. Section Includes:
      1. Ductile-iron pipe and fittings.
      2. Copper pipe and fittings.
      3. Piping joining materials.
      4. Transition fittings.
      5. Dielectric fittings.

1.03 ACTION SUBMITTALS
   A. Product Data: For transition fittings and dielectric fittings.

1.04 INFORMATIONAL SUBMITTALS
   A. System purging and disinfecting activities report.
   B. Field quality-control reports.

1.05 FIELD CONDITIONS
   A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
      1. Notify Construction Manager and Owner no fewer than fourteen days in advance of proposed interruption of water service.
      2. Do not interrupt water service without Owner’s written permission.

PART 2 - PRODUCTS

2.01 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.
   B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."
   C. Comply with NSF Standard 372 for low lead.

2.02 DUCTILE-IRON PIPE AND FITTINGS
   A. Mechanical-Joint, Ductile-Iron Pipe:
      1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
      2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.03 COPPER TUBE AND FITTINGS
   A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
D. Copper Unions:
   1. MSS SP-123.
   4. Solder-joint or threaded ends.

2.04 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.

2.05 TRANSITION FITTINGS
A. General Requirements:
   1. Same size as pipes to be joined.
   2. Pressure rating at least equal to pipes to be joined.
   3. End connections compatible with pipes to be joined.
B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping
   system fitting.
C. Sleeve-Type Transition Coupling: AWWA C219.

2.06 DIELECTRIC FITTINGS
A. See Section 220500 “Basic Plumbing Materials and Methods”.

PART 3 - EXECUTION
3.01 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 ductile-iron piping under building slab with restrained joints according to
   AWWA C600 and AWWA M41.
C. 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 for pressure gages in Section 220519 “Meters and Gages for Plumbing
   Piping” and with requirements for drain valves and strainers in Section 221119 “Domestic
   Water Piping Specialties.”
D. Install shutoff valve immediately upstream of each dielectric fitting.
E. Install domestic water piping level without pitch and plumb.
F. Rough-in domestic water piping for water-meter installation according to utility company's
   requirements.
G. Install piping concealed from view and protected from physical contact by building
   occupants unless otherwise indicated and except in equipment rooms and service areas.
H. 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.

I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

J. Install piping to permit valve servicing.

K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

L. Install piping free of sags and bends.

M. Install fittings for changes in direction and branch connections.

N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 “Sleeves and Sleeve Seals for Plumbing Piping.”

O. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 “Sleeves and Sleeve Seals for Plumbing Piping.”

P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 “Escutcheons for Plumbing Piping.”

3.02 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. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

D. 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.

E. Soldered Joints for Copper Tubing: 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. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.03 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
   1. Fittings for NPS 2 and Larger: Sleeve-type coupling.

3.04 DIELECTRIC FITTING INSTALLATION

A. See section 220500 “Basic Plumbing Material and Methods”.

3.05 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for 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 that required by plumbing code.
   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.

3.06 IDENTIFICATION
   A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
   B. Label pressure piping with system operating pressure.

3.07 FIELD QUALITY CONTROL
   A. Perform the following tests and inspections:
      1. Piping Inspections:
         a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
         b. 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:
            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 authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
         c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
         d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
      2. Piping Tests:
         a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
         b. 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.
         c. 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.
         d. 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 it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
         e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
         f. Prepare reports for tests and for corrective action required.
B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.08 A D J U S T I N G

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Adjust calibrated balancing valves to flows indicated.
4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.09 C L E A N I N G

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. Repeat procedures if biological examination shows contamination.
   e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.10 P I P I N G S C H E D U L E

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. Aboveground domestic water piping, NPS 3 and smaller, shall be the following:
   1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

D. Aboveground domestic water piping, NPS 4 and larger, shall be the following:
1. Mechanical-joint, ductile-iron pipe; standard-pattern, mechanical-joint fittings; and mechanical joints.

3.11 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
2. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION
SECTION 221119
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 220100 “Basic Plumbing Requirements” and Section 220500 “Basic Plumbing Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.02 SUMMARY
A. Section Includes:
   1. Backflow preventers.
   2. Balancing valves.
   3. Temperature-actuated, water mixing valves.
   4. Strainers.
   5. Wall hydrants.
   7. Trap-seal primer valves.
   8. Flexible connectors.
B. Related Requirements:
   1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.

1.03 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: For domestic water piping specialties.
   1. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS
A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

2.02 PERFORMANCE REQUIREMENTS
A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.03 BACKFLOW PREVENTERS
A. Reduced-Pressure-Principle Backflow Preventers (RPZ-1):
   1. Acceptable manufacturers: WATTS, Zurn, and Wilkins.
   3. Operation: Continuous-pressure applications.
   4. Pressure Loss: 12 psig maximum, through middle third of flow range.
   5. Size: See drawings.
   7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
   8. Configuration: Designed for horizontal, straight-through flow.
9. Accessories:
   a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.

B. Double-Check, Backflow-Prevention Assemblies (BFP-1):
   3. Operation: Continuous-pressure applications unless otherwise indicated.

2.04 BALANCING VALVES
A. Copper-Alloy Calibrated Balancing Valves:
   1. Acceptable manufacturers: Bell & Gossett, WATTS and Nibco.
   2. Type: Y-pattern globe valve with two readout ports and memory-setting indicator.
   3. Body: Brass or bronze.
   4. Size: Same as connected piping, but not larger than NPS 2.
   5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.05 TEMPERATURE-ACTUATED, WATER MIXING VALVES
A. Primary, Thermostatic, Water Mixing Valves <TMV-1>:
   3. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
   4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
   5. Material: Bronze body with corrosion-resistant interior components.
   6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
   7. Tempered-Water Setting: see schedule on drawings.
   8. Tempered-Water Design Flow Rate: see schedule on drawings.
   9. Pressure Drop at Design Flow Rate: see schedule on drawings.
   10. Valve Finish: Rough bronze.
   11. Piping Finish: Copper.

B. Individual-Fixture, Water Tempering Valves <TMV-2>:
   2. Standard: ASSE 1070, thermostatically controlled, water tempering valve.
   3. Pressure Rating: 125 psig minimum unless otherwise indicated.
   5. Temperature Control: Adjustable.
   6. Inlets and Outlet: Threaded.
   7. Finish: Rough or chrome-plated bronze.
   8. Tempered-Water Setting: 105 °F
   9. Tempered-Water Design Flow Rate: see schedule on drawings.

2.06 STRAINERS FOR DOMESTIC WATER PIPING
A. Y-Pattern Strainers:
   1. Pressure Rating: 125 psig minimum unless otherwise indicated.
   2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
   3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
   4. Screen: Stainless steel with round perforations unless otherwise indicated.
   5. Perforation Size:
      a. Strainers NPS 2 and Smaller: 0.033 inch.
b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.


2.07 WALL HYDRANTS
A. Non-freeze Wall Hydrants (WH-1):
  1. Acceptable manufacturers: Zurn, Jay R. Smith, Woodford and Josam.
  4. Operation: Loose key.
  5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
  6. Inlet: NPS 3/4 or NPS 1.
  7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
  8. Box: Deep, flush mounted with cover.
  9. Box and Cover Finish: Chrome plated.
 11. Nozzle and Wall-Plate Finish: Rough bronze.
 12. Operating Keys(s): One with each wall hydrant.

2.08 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.

2.09 WATER-HAMMER ARRESTATERS
A. Water-Hammer Arreстатers:
  3. Type: Copper tube with piston.
  4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.10 TRAP-SEAL PRIMER DEVICE
A. Supply-Type, Trap-Seal Primer Device:
  1. Acceptable manufacturers: PPP Inc., Sioux Chief and WATTS.
  5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
  6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
  7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.11 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

3.01 INSTALLATION
A. 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 unacceptable for this application.
   3. Do not install bypass piping around backflow preventers.

B. Install pressure gages on inlet and outlet of water regulator.
C. Install balancing valves in locations where they can easily be adjusted.
D. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install cabinet-type units recessed in or surface mounted on wall as specified.
E. Install Y-pattern strainers for water on supply side of each control valve and pump.
F. Install water-hammer arresters in water piping according to PDI-WH 201.
G. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
H. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

3.02 CONNECTIONS
A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3.03 LABELING AND IDENTIFYING
A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Coordinate list below with products retained in Part 2.
   2. Reduced-pressure-principle backflow preventers.
   3. Double-check, backflow-prevention assemblies.
   5. Primary, thermostatic, water mixing valves.
   6. Primary water tempering valves.
B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL
A. Perform the following tests and inspections:
   1. Test each reduced-pressure-principle backflow preventer and double-check, backflow-prevention assembly according to authorities having jurisdiction and the device’s reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.05 ADJUSTING
A. Set field-adjustable pressure set points of water pressure-reducing valves.
B. Set field-adjustable flow set points of balancing valves.
C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119
PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 20 0800 “Seismic Protection,” Section 22 0100 “Basic Plumbing Requirements,” and Section 22 0500 “Basic Plumbing Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.02 SUMMARY
A. Section Includes:
   1. Pipe, tube, and fittings.
   2. Specialty pipe fittings.
B. Related Requirements:

1.03 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: For hubless, single-stack drainage system.

1.04 INFORMATIONAL SUBMITTALS
A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
B. Field quality-control reports.

1.05 FIELD CONDITIONS
A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Construction Manager and Owner no fewer than two weeks in advance of proposed interruption of sanitary waste service.
   2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS
A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
   2. Waste, Sump Pump Discharge Piping: 50 psig.
B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7

2.02 PIPING MATERIALS
A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
B. 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.

2.03 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS
A. Pipe and Fittings: ASTM A 888 and CISPI 301.
B. Heavy-Duty, Hubless-Piping Couplings:
   2. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.04 PVC PIPE AND FITTINGS
B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
D. 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.”
E. Solvent Cement: ASTM D 2564.
   1. Adhesive primer shall have a VOC content of 510 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.”

2.05 SPECIALTY PIPE FITTINGS
A. Transition Couplings:
   1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
   2. Shielded, Nonpressure Transition Couplings:
      a. Acceptable manufacturers; Mission, MIFAB, or CREMCO.
      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.
      d. End Connections: Same size as and compatible with pipes to be joined.

PART 3 - EXECUTION
3.01 PIPING INSTALLATION
A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
   1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. 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.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 22 08 00. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. 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.
2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
   a. Straight tees, elbows, and crosses may be used on vent lines.
3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
   a. Reducing size of waste piping in direction of flow is prohibited.

K. Lay buried building waste piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Sanitary Waste Piping: 2 percent downward in direction of flow for piping NPS 2 and smaller; 1 percent downward in direction of flow for piping NPS 3 and larger.
2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

N. Install steel piping according to applicable plumbing code.

O. Install underground PVC piping according to ASTM D 2321.

P. Install engineered soil and waste and vent piping systems as follows:

3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

Q. Plumbing Specialties:
1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
   a. Install cleanout fitting with closure plug inside the building in sanitary drainage sump pump discharge piping.
   b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

2. Install drains in sanitary waste gravity-flow piping.
   a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors.
   1. Comply with requirements for sleeves specified in Section 22 05 00 “Basic Plumbing Material and Methods.”

T. Install sleeve seals for piping penetrations of concrete walls and slabs.
   1. Comply with requirements for sleeve seals specified in Section 22 05 00 “Basic Plumbing Material and Methods.”
   2. Install escutcheons for piping penetrations of walls, ceilings, and floors.
   3. Comply with requirements for escutcheons specified in Section 22 05 00 “Basic Plumbing Material and Methods.”

3.02 JOINT CONSTRUCTION
A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. Plastic, Nonpressure-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. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

3.03 SPECIALTY PIPE FITTING INSTALLATION
A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in ODs.

B. Dielectric Fittings:
   1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
   2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
   3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.

3.04 VALVE INSTALLATION
A. Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," for general-duty valve installation requirements.

B. Shutoff Valves:
   1. Install shutoff valve on each sewage pump discharge.
   2. Install gate or full-port ball valve for piping NPS 3 and smaller.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
3.05 HANGER AND SUPPORT INSTALLATION
A. Comply with requirements for seismic-restraint devices specified in Section 220800.
B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
   3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
   5. Vertical Piping: MSS Type 8 or Type 42, clamps.
   6. Install individual, straight, horizontal piping runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
   7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   8. Base of Vertical Piping: MSS Type 52, spring hangers.
C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
D. Support vertical piping and tubing at base and at each floor.
E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
F. 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: 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.
G. Install supports for vertical cast-iron soil piping every 15 feet.
H. Install hangers for 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: 48 inches with 3/4-inch rod.
I. Install supports for vertical PVC piping every 48 inches.
J. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.06 CONNECTIONS
A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
C. Connect waste and vent piping to the following:
   1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Comply with requirements for backwater valves, cleanouts, and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
6. Equipment: Connect waste piping as indicated.
   a. Provide shutoff valve if indicated and union for each connection.
   b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
E. 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.

3.07 IDENTIFICATION
A. Identify exposed sanitary waste and vent piping.
B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.08 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 waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
      a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
      a. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
      a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
      b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
      c. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
   a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
   b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
   c. Air pressure must remain constant without introducing additional air throughout period of inspection.
   d. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

3.09 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping 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.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

A. Aboveground, soil and waste piping NPS 6 and smaller shall be the following:
   1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.

B. Aboveground, vent piping NPS 4 and smaller shall be the following:
   1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.

C. Underground, soil, waste, and vent piping NPS 6 and smaller shall be any of the following:
   1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION
SECTION 221319
SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL
1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 20 0800 “Seismic Protection,” Section 22 0100 “Basic Plumbing Requirements,” and Section 22 0500 “Basic Plumbing Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.02 SUMMARY
A. Section Includes:
   1. Cleanouts.
   2. Through-penetration firestop assemblies.
   4. Floor drains.

1.03 DEFINITIONS
A. PVC: Polyvinyl chloride.
B. FRP: Fiberglass-reinforced plastic.
C. HDPE: High-density polyethylene.
D. PE: Polyethylene.
E. PP: Polypropylene.

1.04 ACTION SUBMITTALS
A. Product Data: For each type of product.

1.05 INFORMATIONAL SUBMITTALS
A. Seismic Qualification Certificates: For FOG disposal systems, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
B. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS
2.01 ASSEMBLY DESCRIPTIONS
A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.02 CLEANOUTS
A. Cast-Iron Exposed Cleanouts:
   1. Approved manufacturers are J. R. Smith, Josam, and Zurn.
   2. Standard: ASME A112.36.2M.
   3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:
1. Approved manufacturers are J. R. Smith, Josam, and Zurn.
2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Not required.
7. Closure: Brass plug with tapered threads.
8. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Heavy Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:
1. Approved manufacturers are J. R. Smith, Josam, and Zurn.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
   a. Brass.
   b. Countersunk head.
   c. Drilled and threaded for cover attachment screw.
   d. Size: Same as or not more than one size smaller than cleanout size.

2.03 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:
1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.

B. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:
1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.
2.04 DRAIN ASSEMBLIES
A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.05 FLOOR DRAINS
A. Cast-Iron Floor Drains <FD-1, FS-1>:
1. Approved manufacturers are Josam, J. R. Smith and Zurn.
2. See schedule on drawings for further information.

PART 3 - EXECUTION
3.01 INSTALLATION
A. 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.
B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
D. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
1. Comply with requirements in Section 078413 "Penetration Firestopping."
E. Install floor-drain, trap-seal primer fittings on inlet to floor drains and floor sinks.
1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.
F. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
G. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
H. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
I. Install fire-rated wood-blocking reinforcement for wall-mounting-type specialties.
J. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
K. 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.
3. 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.
4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
   a. Maintain integrity of waterproof membranes where penetrated.
5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

3.02 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to equipment to allow service and maintenance.
C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
E. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

3.03 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign:
B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
   1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.04 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 223400
FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary
Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 220100 “Basic Plumbing Requirements” and Section 220500 “Basic Plumbing
Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.02 SUMMARY
A. Section Includes:
   1. Commercial, gas-fired, high-efficiency, storage, domestic-water heaters.
   2. Domestic-water heater accessories.

1.03 ACTION SUBMITTALS
A. Product Data: For each type and size of domestic-water heater indicated. Include rated
   capacities, operating characteristics, electrical characteristics, and furnished specialties
   and accessories.
B. Shop Drawings:
   1. Wiring Diagrams: For power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS
A. Product Certificates: For each type of commercial, gas-fired domestic-water heater, from
   manufacturer.
B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to
   authorities having jurisdiction.
C. Source quality-control reports.
D. Field quality-control reports.
E. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in
   emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in
   NFPA 70, by a qualified testing agency, and marked for intended location and
   application.
B. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to
   comply with ASHRAE/IESNA 90.1.
C. ASME Compliance:
   1. Where ASME-code construction is indicated, fabricate and label commercial,
      domestic-water heater storage tanks to comply with ASME Boiler and Pressure
      Vessel Code: Section VIII, Division 1.
   2. Where ASME-code construction is indicated, fabricate and label commercial,
      finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure
      Vessel Code: Section IV.
D. NSF Compliance: Fabricate and label equipment components that will be in contact with
   potable water to comply with NSF 61 Annex G, "Drinking Water System Components -
   Health Effects."
1.07 COORDINATION
A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.08 WARRANTY
A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including storage tank and supports.
   b. Faulty operation of controls.
   c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.
   a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:
      1) Storage Tank: Five years.
      2) Controls and Other Components: Two years.

PART 2 - PRODUCTS
2.01 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS
A. Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:
   3. Description: Manufacturer’s proprietary design to provide at least 95 percent combustion efficiency at optimum operating conditions.
      a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
         1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
      b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
      c. Lining: Glass complying with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
   5. Factory-Installed Storage-Tank Appurtenances:
      a. Anode Rod: Replaceable magnesium.
      b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
      c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
      d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
      e. Jacket: Steel with enameled finish.
      f. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for gas-fired, high-efficiency Minimum efficiency 85-96%, domestic-water heaters and natural-gas fuel.
      g. Temperature Control: Adjustable thermostat.
      h. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
      i. Combination Temperature- and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

B. Capacity and Characteristics:
1. See schedule on drawings.

2.02 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:
1. Acceptable manufacturers: Bell & Gossett, Amtrol, and Wessels Tank Co.
2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.
3. Construction:
   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
   b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.
4. Capacity and Characteristics:
   a. See schedule and drawings.

B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.

C. Heat-Trap Fittings: ASHRAE 90.2.

D. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and calibrated balancing valves to provide balanced flow through each domestic-water heater.

E. Comply with requirements for shutoff valves specified in Section 220523 "Valves".
   1. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."


G. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 1/2-psig pressure rating as required to match gas supply.

H. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
   2. Oil-Fired, Domestic-Water Heaters: ASME rated and stamped.

I. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.

J. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Provide dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.

K. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.03 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect assembled domestic-water heaters and storage tanks specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
B. Hydrostatically test commercial domestic-water heaters and storage tanks to minimum of one and one-half times pressure rating before shipment.

C. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.

2. Maintain manufacturer's recommended clearances.

3. Arrange units so controls and devices that require servicing are accessible.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

7. Install anchor bolts to elevations required for proper attachment to supported equipment.

8. Anchor domestic-water heaters to substrate.

B. Install domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "Valves."

C. Install gas-fired, domestic-water heaters according to NFPA 54.

1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.

2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.

3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.

4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 231123 "Facility Natural-Gas Piping."

D. Install commercial domestic-water heaters with seismic-restraint devices.

E. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for
domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

G. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

H. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Section 220523 "Valves" and comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

I. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.

J. Fill domestic-water heaters with water.

K. Charge domestic-water compression tanks with air.

3.02 CONNECTIONS

A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."

B. Comply with requirements for gas piping specified in Section 226323 "Natural-Gas Piping."

C. Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.03 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Train Owner’s maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters.
SECTION 224300
PLUMBING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 220100 “Basic Plumbing Requirements” and Section 220500 “Basic Plumbing Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.02 SUMMARY
A. Section includes the following fixtures and specialties:
   1. Water closets.
   2. Flushometer valves.
   3. Toilet seats.
   4. Sinks.
   5. Supports.

1.03 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fixtures.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For plumbing fixtures and faucets to include in operation and maintenance manuals.
   1. In addition to items specified in Section 017823 “Operation and Maintenance Data,” include the following:
      a. Servicing and adjustments of flushometer valves and electronic sensors.

PART 2 - PRODUCTS

2.01 WATER CLOSETS
A. Water Closets.

2.02 FLUSH VALVES
A. Flush valves.

2.03 LAVATORIES
A. Lavatories.
   1. Acceptable manufacturers: Kohler, American Standard and Sloan.

2.04 LAVATORY FAUCETS
A. Lavatory faucets.
   2. For public lavatories include ASSE 1070 certified mixing device, see Section 221119 “Domestic Water Piping Specialties”.
2.05 TOILET SEATS
A. Toilet Seats.
   1. Acceptable manufacturers: Bemis, Church.

2.06 SINK FAUCETS
A. Sink faucets.

2.07 SUPPORTS (CARRIERS)
A. Supports (carriers).
   1. Acceptable manufacturers: Zum, Josam and Jay R. Smith.

2.08 SUPPLY FITTINGS
A. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
B. Standard: ASME A112.18.1/CSA B125.1.
C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.
D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
E. Operation: Loose key.
F. Risers: NPS 1/2 chrome-plated, rigid-copper pipe and brass straight or offset tailpieces.

2.09 WASTE FITTINGS
A. Waste fittings
   1. Acceptable manufacturers: Keeney Mfg, Wolverine Brass and Dearborn Brass.

2.10 GROUT
B. Characteristics: Nonshrink; recommended for interior and exterior applications.
C. Design Mix: 5000-psi, 28-day compressive strength.
D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION
3.01 EXAMINATION
A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
B. Examine walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION
A. Install plumbing fixtures level and plumb according to roughing-in drawings & manufacturer’s instructions.
B. Install supports, affixed to building substrate, for wall-mounted fixtures.
   1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
   2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
   3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
C. Install counter-mounted fixtures in and attached to casework.

D. Install water-supply piping with stop on each supply to each fixture, including showers, to be connected to water-distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball or gate valve if supply stops are not specified with fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."

E. Install flushometer valves on water closets & urinals.

F. Install flushometer valves for accessible water closets & urinals with lever handle mounted on wide side of compartment.

G. Install toilet seats on water closets.

H. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts, if faucets are not available with required rates and patterns. Include adapters if required.

I. Install laminar-flow, faucet-spout fittings in faucet spouts where laminar-flow fittings are specified.

J. Install shower flow-control fittings with specified maximum flow rates in shower arms.

K. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.

L. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

M. Seal joints between plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

N. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

O. Install accessible plumbing fixtures at handicapped/elderly mounting heights according to ICC/ANSI A117.1.

P. Install an ASSE 1070 mixing device at each point of use location for every public lavatory.

3.03 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with requirements for water piping specified in Section 221116 "Domestic Water Piping."

C. Comply with requirements for soil and waste drainage piping and vent piping specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Comply with requirements for atmospheric vent piping specified in Section 221316 "Sanitary Waste and Vent Piping."

E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.04 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning plumbing fixtures, fittings, and controls.
B. Adjust water pressure at faucets and flushometer valves to produce proper flow.
C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.05 CLEANING AND PROTECTION
A. After installing plumbing fixtures, inspect and repair damaged finishes.
B. Clean plumbing fixtures, faucets, and other fittings with manufacturers’ recommended cleaning methods and materials.
C. Provide protective covering for installed fixtures and fittings.
D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224300
SECTION 226323  
NATURAL-GAS PIPING

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Pipes, tubes, and fittings.
   2. Piping specialties.
   3. Piping and tubing joining materials.
   4. Valves.
   5. Pressure regulators.
   6. Concrete bases.

1.03 DEFINITIONS
A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.04 PERFORMANCE REQUIREMENTS
A. Natural-Gas System Pressure within Buildings: Primary pressure is less than 0.5 psig.
B. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.05 SUBMITTALS
A. Product Data: For each type of the following:
   1. Piping specialties.
   2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
   3. Pressure regulators. Indicate pressure ratings and capacities.
   4. Dielectric fittings.
B. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
C. Welding certificates.
D. Field quality-control reports.
E. Operation and Maintenance Data: For pressure regulators and valves to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE
A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.08 PROJECT CONDITIONS
A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
   1. Notify Owner no fewer than seven days in advance of proposed interruption of natural-gas service.
   2. Do not proceed with interruption of natural-gas service without Owner's written permission.

1.09 COORDINATION
A. Coordinate sizes and locations of concrete bases with actual equipment provided.
B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS
2.01 PIPES, TUBES, AND FITTINGS
A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
   4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
      b. End Connections: Threaded or butt welding to match pipe.
      c. Lapped Face: Not permitted underground.
      e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
   5. Mechanical Couplings:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Dresser Piping Specialties; Division of Dresser, Inc.
2) Smith-Blair, Inc.
   b. Steel flanges and tube with epoxy finish.
   c. Buna-nitrile seals.
   d. Steel bolts, washers, and nuts.
   e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
   f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

2.02 PIPING SPECIALTIES

A. Y-Pattern Strainers:
   1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
   3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

B. 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.

2.03 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.


2.04 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
   1. CWP Rating: 125 psig.
   3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
   5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
   6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

2.05 PRESSURE REGULATORS

A. General Requirements:
   1. Single stage and suitable for natural gas.
   2. Steel jacket and corrosion-resistant components.
   3. Elevation compensator.
   4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

2.06 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
B. **Dielectric Unions:**
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      e. Wilkins; a Zurn company.
   2. Description:
      b. Pressure Rating: 125 psig minimum at 180 deg F.
      c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. **Dielectric Flanges:**
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      d. Wilkins; a Zurn company.
   2. Description:
      b. Factory-fabricated, bolted, companion-flange assembly.
      c. Pressure Rating: 125 psig minimum at 180 deg F.
      d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

2.07 **LABELING AND IDENTIFYING**
A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 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, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.01 **EXAMINATION**
A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **PREPARATION**
A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

3.03 **INDOOR PIPING INSTALLATION**
B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. 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.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
   1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed 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 weatherproof vent cap.
   1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
   2. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
      a. Exception: Tubing passing through partitions or walls does not require striker barriers.
   3. Prohibited Locations:
      a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
      b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. 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.
T. Do not use natural-gas piping as grounding electrode.
U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
V. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."
W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

3.04 VALVE INSTALLATION
A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
C. Install earthquake valves aboveground outside buildings according to listing.
D. Install anode for metallic valves in underground PE piping.

3.05 PIPING JOINT CONSTRUCTION
A. Ream ends of pipes and tubes and remove burrs.
B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
C. Threaded Joints:
   1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
   2. Cut threads full and clean using sharp dies.
   3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
   4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
   5. 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.
D. Welded Joints:
   2. Bevel plain ends of steel pipe.
   3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

3.06 HANGER AND SUPPORT INSTALLATION
A. Install seismic restraints on piping.
B. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.

3.07 CONNECTIONS
A. Connect to utility’s gas main according to utility’s procedures and requirements.
B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
C. Install piping adjacent to appliances to allow service and maintenance of appliances.
D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.08 LABELING AND IDENTIFYING
A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.
B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.09 PAINTING
A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.
B. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
   c. Topcoat: Interior latex semigloss.
   d. Color: Gray.

2. Alkyd System: MPI INT 5.1E.
   c. Topcoat: Interior alkyd semigloss.
   d. Color: Gray.
C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 CONCRETE BASES
A. Concrete Bases: Anchor equipment to concrete base 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. Use 3000-psig, 28-day, compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.11 FIELD QUALITY CONTROL
A. Perform tests and inspections.
B. Tests and Inspections:
   1. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.
C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
D. Prepare test and inspection reports.

3.12 DEMONSTRATION
A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.13 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. Steel pipe with malleable-iron fittings and threaded joints.
   2. Steel pipe with steel welding fittings and welded joints.
B. Aboveground, branch piping NPS 1 and smaller where piping is concealed and inaccessible shall be the following:
   1. Steel pipe with steel welding fittings and welded joints.

3.14 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE
A. Valves for pipe sizes NPS 2 and smaller shall be one of the following:

END OF SECTION 226323
SECTION 23 0100
BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY
A. This Section includes general administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
   1. Submittals.
   3. Record documents.

1.02 RELATED DOCUMENTS
A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 23.

1.03 CONTRACTOR'S SUBMITTAL RESPONSIBILITIES
A. General: Follow the procedures specified in Division 01. In addition to the requirements specified in Division 01, comply with the following:
   1. Increase by two (2) the quantity of print copies required by Division 01 for submittals, if paper submittals are used. (Paperless electronic submittals are preferred.)
   2. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number. Transmit via email. Include PDF transmittal form. Include information in email subject line as to project name, project number, submittal number, and applicable specification section number.
   3. Submit line-by-line specification verification for equipment other than the “basis of design” as further described in the following article “Material and Equipment Selection”.

B. General: Submittals are not requested for all products covered in the specifications. Submit only the data requested under the submittals portion of each specification section or where indicated in a Submittal Log, if included within Division 01. Un-requested submittals will not be processed, reviewed or returned and the contractor will be notified that the submittal will not be reviewed by the engineer of record.
   1. Non-requirement of submittals, when so noted, is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.
   2. Any deviation from specified items is considered a substitution. If the contractor desires to use other than specified items, then a formal request for substitution must be submitted prior to bid date (no exceptions), in accordance with the procedures and time limitations set forth in Division 01. Where not defined in Division 01, requests for substitutions shall be submitted no less than ten (10) working days prior to bid date. Review of substitution requests by the Engineer shall be done at the expense of the contractor. Charges for this substitution review shall be calculated based on the Engineer’s standard hourly rates, as defined in their contract with the Owner.

C. It is the responsibility of the Contractor to ensure that all submittals have been reviewed for total completeness and accuracy as to the requirements of the specifications and drawings before being submitted to the Engineer for review.
1. One comprehensive submittal shall be provided for each individual specification section. All required submittal information called for in each individual specification section shall be included in the submittal.

2. The Engineer of Record shall not be responsible for informing the contractor on items that have not been included and are necessary for a complete review of the required submittal information for a specification section.

3. The Engineer of Record shall have the option of returning any submittal, unmarked, if all required documentation called for in the specifications has not been provided in the submittal.

4. The Engineer of Record shall review each submittal no more than two (2) times and return to the contractor with the appropriate disposition.

5. If the Engineer of Record is required to review a submittal a second time, it shall be limited to review of the changed information, clearly highlighted by the submitter, and/or confirmation of documentation only and it shall be returned to the contractor with the appropriate disposition.

6. If the submittal is required to be reviewed a third time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer’s standard hourly rates, as defined in their contract with the Owner.

D. Operation and Maintenance Manuals: All items required for insertion into each Operation and Maintenance (O&M) Manual are called out in the submittals portion of each specification section or in a Submittal Log, if included within Division 01. It is the responsibility of the Contractor to ensure that the O&M submittal has been reviewed and includes all the requirements of the specifications. The Engineer of Record shall review the submittal for the Operation and Maintenance Manual one (1) time and return to the contractor with the appropriate disposition.

1. If the submittal is required to be reviewed a second time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer’s standard hourly rates, as defined in their contract with the Owner.

2. Submittals for the Operation and Maintenance Manual must be original documentation.

3. Photo copies of marked up Operations and Maintenance submittals are not acceptable.

E. Refer to Division 01 and each individual Division 23 Section for additional submittal requirements.

1.04 REFERENCED STANDARDS


1.05 MATERIAL AND EQUIPMENT SELECTION

A. Product Options: The specification of each item of major mechanical equipment required for the project may include a list of manufacturers, with one “basis of design” manufacturer, type, and model identified by virtue of their listing in the equipment schedule on the Drawings. Where several manufacturers in addition to the “basis of design” manufacturer are listed in the specifications, it shall be understood that the words “or approved equal by” are implied to precede each of the other manufacturer’s names.

1. The manufacturers other than the “basis of design” may be furnished at the contractor’s option in lieu of the “basis of design” product, provided that the selected manufacturer’s product is equal in all material and functional respects. In addition to submittal requirements that may be specified in this section, submit a
line-by-line written verification of the applicable specification section(s) identifying compliance with or variations from the specified features, materials, performance, capacities, weight, size, durability, energy consumption and efficiency, warranty, and visual impact (if exposed to view by other than maintenance persons). The burden of proof of manufacturer/product equality is on the contractor.

2. Where a product is not scheduled on the drawings and, therefore, where no “basis of design” is indicated, selection among all of the listed manufacturers and products is at the contractor’s option, subject to the requirements of the Contract Documents.

3. Products of manufacturers not listed in the Contract Documents are considered Substitutions and are not permitted, except as provided under the General and Supplementary Conditions and Division 01 Specifications. Full compliance with Division 01 section “Product Substitutions” is mandatory for acceptance of products or manufacturers not listed.

B. Listing of a manufacturer does not imply approval of that manufacturer’s standard product or products. Rather, listing of a manufacturer indicates only a general acceptance of that manufacturer’s name and reputation. Final approval is subject to full compliance with these Contract Documents.

C. Model numbers identified on the Drawings notwithstanding, all equipment must comply with the requirements of these Contract Documents. Do not assume that a manufacturer’s standard product is acceptable as is. For example, one or more custom modifications, custom colors or finishes, manufacturer’s options, and/or accessories may be required to meet the specified requirements.

D. Where drawings indicate sizes, profiles, connections, and dimensional requirements of material and equipment, these are based on the “basis of design” manufacturer, type and model indicated. In the event that equipment of power, dimensions, capacities, layout, connections, and/or ratings differing from the “basis of design” are selected by the contractor and approved by the Owner’s representative, any necessary adjustments are the contractor’s responsibility. All connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, pipe and duct sizes, pipe and duct layout, and the like shall be adjusted by the contractor to suit the equipment provided. No additional costs will be approved for these changes. Should revisions to the design because of contractor’s selection of manufacturer, type, or model other than the “basis of design” require additional review and/or redesign by an Architect or Engineer, the contractor shall reimburse the Owner for Owner’s added professional fee expenses.

E. Where two or more materials are listed in the “Part 2 – Products” subsection of any Division 23 section, do not assume that the selection of materials is the contractor’s option. Refer to “Part 3 – Execution” subsection of that same Division 23 section for an explanation of which specific material(s) shall be used for which specific application(s). For example, Part 2 may list several types and grades of piping, and Part 3 will describe which type and grade of pipe to use for a given application.

1.06 ELECTRONIC MEDIA AND FILES

A. Electronic media files of the contract drawings in AutoCAD or PDF format and copies of the specifications in PDF format may be requested.

B. Complete and return a signed “Electronic File Transmittal” form provided by Ross & Baruzzini upon request for electronic media.

C. Obtain approval from the appropriate Design Professional for use of their part of the documents if the information requested includes information prepared by other than Ross & Baruzzini.
D. The electronic contract documents may be used for preparation of shop drawings and record drawings only. The information may not be used in whole or in part for any other project.

E. The drawings prepared by Ross & Baruzzini for bidding purposes may not be used directly for raceway layout drawings or coordination drawings.

F. The use of these documents does not allow relief from the responsibility for coordination of work with other trades and verification of space available for the installation.

G. The information is provided to expedite the project with no guarantee by Ross & Baruzzini as to the accuracy or correctness of the information provided. Ross & Baruzzini accepts no responsibility or liability for the use of the provided information.

1.07 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 01. In addition to the requirements specified in Division 01, indicate the following installed conditions:

1. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.

2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Indicate actual inverts and horizontal locations of all underground piping.

3. Valve location diagrams, complete with valve tag chart. Refer to Division 23 Section “Basic Mechanical Materials and Methods.”

4. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

5. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

1.08 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 01. In addition to the requirements specified in Division 01, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

5. Facsimiles or photo copies are not allowed as submittals for operating and maintenance manuals. Submittals for operating and maintenance manuals must be on original manufacturer printed stock.

B. In addition to the above, comply with ASHRAE Guideline 4-2008 (RA 2013) Preparation of Operating and Maintenance Documentation for Building Systems.

PART 2 - PRODUCTS (NOT APPLICABLE)
PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. During construction, meet or exceed the recommended Design Approaches of SMACNA IAQ Guideline for Occupied Buildings under Construction.

B. Protect stored on-site or installed absorptive materials from moisture damage. Materials directly exposed to moisture via precipitation, water leaks, or condensation shall be removed from the jobsite and replaced.

END OF SECTION 23 0100
SECTION 23 0500
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY
A. This Section includes the following basic mechanical materials and methods to complement other Division 23 Sections:
   1. Materials and installation instructions common to mechanical systems.
   2. Pipe joining materials and methods.
   3. Flexible pipe connectors.
   4. Modular sleeve seals.
   5. Pipe sleeves.
   7. Labeling and identifying mechanical systems and equipment.
   8. Concrete base construction requirements.
   9. Coordination with Structural work.
   10. Field-fabricated equipment supports.
   11. Selective Demolition.
   12. Cutting and patching.

1.02 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 23 0100 “Basic Mechanical Requirements” apply to the work of this Section as if fully repeated herein.
C. Pipe and pipe fitting materials are specified in individual Division 23 piping system Sections.

1.03 DEFINITIONS
A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
F. The following abbreviations are used throughout Division 23 Specification Sections:
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. CR: Chlorosulfonated polyethylene synthetic rubber.
   4. EPDM: Ethylene propylene diene terpolymer rubber.
   5. NBR: Acrylonitrile-butadiene rubber.
   6. NP: Nylon plastic.
   7. PE: Polyethylene plastic.
   8. PVC: Polyvinyl chloride plastic.
1.04 SUBMITTALS
A. Product Data: For dielectric fittings, transition couplings, flexible pipe connectors, modular sleeve seals, escutcheons, and identification materials and devices.
B. Shop Drawings: Detail fabrication and installation for supports and anchorage for mechanical materials and equipment.

1.05 QUALITY ASSURANCE
A. Welding: Qualify welding processes and operators for structural steel according to AWS D1.1 “Structural Welding Code – Steel.”
B. Welding: Qualify welding processes and operators for piping according to ASME “Boiler and Pressure Vessel Code,” Section IX, “Welding and Brazing Qualifications.”
   2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.
   3. Contactor shall retain all welding certificates on file and produce them for review upon request by the Owner and/or Owner’s representative.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor or roof, if stored thereupon. Protect flanges, fittings, and piping specialties from moisture and dirt.
B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
C. Protect ductwork interiors from the elements and foreign materials throughout construction. Deliver ducts with shop-applied impervious protective covering over all open ends. Maintain protective end coverings through shipping, storage, and handling to prevent entrance of dirt, debris, and moisture. Elevate stored ducts above grade. As ductwork is installed, remove protective end covering as each successive segment is connected, but with protective end covering maintained over open ends remaining exposed.
D. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.07 SEQUENCING AND SCHEDULING
A. Coordinate mechanical equipment installation with other building components.
B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section “Access Doors and Panels.”
G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

H. Coordinate connection of electrical services.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Transition Couplings:
   a. Dresser Industries, Inc.
   b. or approved equal.

2. Flexible Pipe Connectors:
   a. Flexicraft Industries, Inc.
   b. Hyspan Precision Products, Inc.
   c. Mason Industries, Inc.
   d. The Metraflex Company
   e. Proco Products, Inc.

3. Modular Sleeve Seals:
   a. Calpico, Inc.
   b. Flexicraft Industries, Inc. “PipeSeal”
   c. GPT div. of EnPro Industries, Inc “Link-Seal”
   d. The Metraflex Company

4. Identifying Devices and Labels:
   b. Brimar Industries, Inc.
   c. Kolbi Industries, Inc.
   d. Panduit Corp.
   e. Seton Name Plate Co.

2.02 PIPE AND PIPE FITTINGS

A. Refer to individual Division 23 piping Sections for pipe and fitting materials and joining methods.

2.03 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

C. Pipe-Flange Joining Gaskets: ASME B16.21, EPDM, flat, asbestos-free, 1/8-inch (3.2-mm) thickness, unless noted otherwise.
   1. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   2. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

D. Pipe-Flange Joining Bolts and Nuts: ASME B18.2.1 bolts with ASME B18.2.2 nuts, carbon steel, unless otherwise indicated.
   1. Bolts and nuts shall be Type 304 or Type 316 stainless steel, if installed on stainless steel piping, and matching the grade of stainless steel piping.
   2. Bolts and nuts shall be Type 304 stainless steel if installed on uninsulated piping located outdoors.
3. Bolts and nuts shall be Type 316 stainless steel if installed on uninsulated direct-bury piping.

E. Solder Filler Metals: ASTM B32 lead-free alloys. Include water-flushable flux according to ASTM B813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements: Manufacturer’s standard solvent cements for the following:
   1. ABS Piping: ASTM D2235.
   2. CPVC Piping: ASTM F493.
   3. PVC Piping: ASTM D2564. Include primer according to ASTM F656.
   4. PVC to ABS Piping Transition: ASTM D3138.


J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts unless noted otherwise.
   1. Bolts and nuts shall be Type 304 stainless steel if installed on uninsulated piping located outdoors.
   2. Bolts and nuts shall be Type 316 stainless steel if installed on uninsulated direct-bury piping.

K. Transition Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
   2. Followers: ASTM A47 (ASTM A47M) malleable iron or ASTM A536 ductile iron.
   5. Finish: Enamel paint.

2.04 FLEXIBLE PIPE CONNECTORS

A. General: Fabricated from materials suitable for system fluid and that will provide equipment-pipe connections.

B. Flexible Pipe Connectors for Copper Piping: Corrugated bronze inner tubing covered with interwoven bronze wire braid. Include copper-tube ends, brazed to hose.

C. Flexible Pipe Connectors for Steel Piping: Corrugated stainless steel inner tubing covered with interwoven stainless-steel wire braid.

D. Performance Rating Requirements:
   1. Misalignment: Rated for ¾-inch (20-mm) permanent lateral offset.
   2. Length: As needed to allow offset rating above, but not less than 9-inches (230 mm).
   3. Design Working Pressure: 150 psig (1035 kPa) at 300°F (149°C).

E. Schedule of End Connections:
   1. 2-Inch NPS (DN50) and Smaller, Copper Pipe: Copper tube end connections suitable for soldering to adjacent piping; except that brazed end connections are required for refrigerant service.
   2. 2-Inch NPS (DN50) and Smaller, Steel Pipe: Threaded-end carbon steel nipples welded to hose; except that stainless-steel ends are required for natural gas service or where mated to stainless steel piping.
   3. 2½-Inch NPS (DN65) and Larger: Carbon-steel flanged end connections welded to hose and drilled to meet ANSI Class 150; except that stainless-steel flanged
end connections are required for natural gas service or where mated to stainless steel piping.

F. Flexible pipe connectors specified herein are for use at the piping connection to a piece of mechanical equipment, including but not limited to pumps. These are not acceptable for use where “expansion joints” or “pipe expansion fittings” are called out. Refer to Division 23 Section “Pipe Expansion Fittings” for pipe expansion joints or pipe expansion fittings.

2.05 MODULAR SLEEVE SEALS
A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.
B. Sealing Elements: Interlocking links of EPDM or Nitrile rubber, shaped to fit surface of pipe. Include number and size of links required for size of pipe. Modular seal elements shall have a tensile strength of not less than 1200 psi per ASTM D412 test method.
C. Pressure Plates: Select among reinforced nylon polymer, steel zinc dichromate, or stainless steel. Include two for each sealing element.
D. Connecting Bolts and Nuts: Type 304 or 316 stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.
E. Minimum Temperature Rating: \(-40^\circ F\) to \(+210^\circ F\) (\(-40^\circ C\) to \(+99^\circ C\)).

2.06 PIPE SLEEVES
A. The following sleeve materials are for wall, floor, slab, and roof penetrations.
B. Steel Pipe: ASTM A53, Type E, Grade A, 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 setscrews.
E. PE: Manufactured, reusable, tapered, cup shaped, smooth outer surface, with nailing flange for attaching to wooden forms.
F. Contractor’s Option: Pre-engineered, UL-listed fire-resistance rated and watertight cast-in-place floor sleeving systems meeting the following specifications will be acceptable in lieu of traditional floor sleeves with field-installed firestop, at contractor’s option.
   1. Description: Cast-in-place, factory-assembled, one-piece watertight firestop device for use in concrete floors formed with wood and/or steel decking to protect penetrating objects from expansion and contraction of concrete, thermal and seismic movement, and the passage of air, smoke, fire, and hot gasses.
   2. Manufacturer: Subject to compliance with requirements, provide Hydroflame™ sleeving system by Hubbard Enterprises / Holdrite; or approved equal.
   3. Include an outer sleeve lined with an intumescent strip; and a radial extended flange attached to one end of the sleeve for fastening to concrete formwork; or wide outside wings attached to one end of the sleeve for fastening to metal deck concrete formwork and span deck corrugations.
   4. Include a waterstop gasket and mid-body seal consisting of one to three concentric raised rings for embedment and sealing to the concrete slab. For applications involving a corrugated deck, also include a cone attached to the base for extending the device through the metal deck.
   5. Product shall provide a two-hour fire-resistance rated assembly when tested according to ASTM E814 or ANSI/UL 1479.
2.07 ESCUTCHEONS AND FLOOR PLATES
A. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners. Use only for piping with a fitting or sleeve protruding from wall.
B. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
C. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.
D. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
E. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.08 IDENTIFYING DEVICES AND LABELS
A. General: Manufacturer’s standard products of categories and types required for each application as referenced in other Division 23 Sections. If more than one type is specified for application, selection is installer’s option, but provide one selection for each product category.
B. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
C. Equipment Nameplates: Metal nameplate with operational data engraved or stamped; permanently fastened to equipment; furnished and factory-installed by original equipment manufacturer.
   1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
   2. Location: Accessible and visible location.
   1. Nomenclature: Heating Water Supply, Heating Water Return, Chilled Water Supply, Chilled Water Return, Natural Gas, etc. as required per service. Match name to the name given on Drawings (full names, not abbreviations).
   2. Color: Per ASME A13.1 Standard per service, unless noted otherwise.
   3. Flow Direction: Indicate flow direction via arrows on each label.
   4. Pipe Size: Indicate nominal pipe size, in inches, on each label.
   5. Example: ←2" CHILLED WATER RETURN←
E. Plastic Duct Markers: Manufacturer’s standard color-coded, laminated plastic. Comply with the following color code:
   1. Green: Cold air.
   2. Yellow: Hot air.
   3. Yellow/Green or Green: Supply air.
   4. Blue: Exhaust, outside, return, and mixed air.
   5. For hazardous exhausts, use colors and designs recommended by ASME A13.1.
   7. Example: ←RETURN AIR←
F. Engraved Plastic-Laminate Signs: ASTM D709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated.
   1. Fabricate in sizes required for message.
   2. Engraved with engraver’s standard letter style, of sizes and with wording to match equipment identification.
   3. Punch for mechanical fastening.
   4. Thickness: 1/16-inch (1.6 mm), for units up to 20 sq. in. (130 sq. cm) or 8 inches (200 mm) long; 1/8-inch (3.2 mm) for larger units.
5. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.

G. Valve Tags: Photo-anodized barcode tags with ¼-inch (6-mm) letters and numbers. Include 5/32-inch (4-mm) hole for fastener.
   1. Material: 0.032-inch (0.8-mm) thick anodized aluminum.
   2. Color: Silver background with black characters.
   3. Printed Nomenclature: Piping system abbreviation and sequenced number; e.g., CWS-23 for chilled water supply valve #23; HWR-12 for hot water return valve #12.
   4. Barcode: Two-dimensional Data Matrix ECC 200 barcode symbology. QR Code is also acceptable. Prior to manufacture, obtain valve tag information from owner’s property manager for encoding into the barcode. Include valve number, piping system, system abbreviation, location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

H. Valve Tag Fasteners: Brass, wire-link chain or stainless steel beaded chain.

I. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.
   1. Multiple Systems: If multiple systems of same generic name are indicated, provide identification that indicates individual system number and service such as “Boiler No. 3,” “Air Supply No. 1H,” or “Standpipe F12.”

2.09 CONCRETE AND GROUT

A. Concrete: For all minor concrete work required for mechanical installations, such as concrete equipment bases and supports, refer to Division 03 Sections for specification of cast-in-place concrete and reinforcing materials, whose requirements apply to the work of Division 23 as if fully reproduced herein.

2.10 PAINTING AND FINISHING

A. For all painting and finishing work required for mechanical installations, as described in Part 3 of this Section and/or on the Drawings, refer to Division 09 Sections for specification of paint and finishing materials, whose requirements apply to the work of Division 23 as if fully reproduced herein.

PART 3 - EXECUTION

3.01 GENERAL MECHANICAL INSTALLATION REQUIREMENTS

A. Verify all dimensions by field measurements.

B. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

C. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.

D. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

E. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
F. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.02 PIPING SYSTEM INSTALLATION REQUIREMENTS

A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 23 piping Sections specify unique piping installation requirements.

B. General Locations and Arrangements: 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 components with pressure rating equal to or greater than system operating pressure.

D. Install piping at indicated slope, and free of sags and bends.

E. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal. Install piping to allow application of insulation plus 1-inch (25-mm) clearance around insulation.

F. Locate groups of pipes parallel to each other, arranged and spaced to permit valve servicing.

G. Install fittings for changes in direction and branch connections. Install couplings according to manufacturer’s written instructions.

H. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

I. Electrical Equipment Spaces: Route piping to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

J. Piping Support: As specified in Division 23 Section “Hangers and Supports.”

3.03 PIPING JOINING REQUIREMENTS

A. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections.

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 B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA’s “Copper Tube Handbook,” using lead-free solder alloy complying with ASTM B32.

E. Brazed Joints: Construct joints according to AWS’s “Brazing Handbook,” “Pipe and Tube” Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
   2. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
   3. Align threads at point of assembly.
   4. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
5. 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.

   1. Apply one coat of self-priming, rust-inhibitor paint around the entire circumference of each welded pipe joint; regardless of whether or not the piping is specified to be painted. Paint may be brush-applied, roller-applied, or spray-applied at contractor’s option.

H. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
   1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: ASTM D2235 and ASTM D2661.
   4. PVC Pressure Piping: ASTM D2672.
   5. PVC Non-pressure Piping: ASTM D2855.
   6. PVC to ABS Non-pressure Transition Fittings: Procedure and solvent cement according to ASTM D3138.

J. Piping Connections: Make connections according to the following, unless otherwise indicated.
   1. Install unions, in piping 2-inch NPS (DN50) and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS (DN50) or smaller threaded pipe connection.
   2. Install flanges, in piping 2½-inch NPS (DN65) and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
   3. Install dielectric flanges to connect piping materials of dissimilar metals.
   4. Valve Caps: Any valve that represents a termination or the end of a run (e.g., blowdown or drain valve, hose-end valve, etc.) shall be fitted with a permanent but removable cap, plug, or blind flange matching the valve construction, to minimize risk in the event the valve is accidentally opened under pressure.

3.04 PIPE-PENETRATION INSTALLATION REQUIREMENTS

A. Except as noted otherwise, install escutcheons for both insulated and bare piping in the following cases:
   1. New piping of penetrations of newly-constructed walls, ceilings, and floors.
   2. New piping penetrations of existing walls, ceilings, and floors.
   3. Existing piping which penetrates newly-constructed walls, ceilings, and floors.

B. Escutcheons are not required in the following cases. Note that some form of closure of the annular or overcut opening (for reasons of acoustics, fire/smoke, sight, etc.) may still be required by other provisions of these documents.
   1. Existing piping which penetrates existing walls, ceilings, and floors.
   2. Wall penetrations in an unfinished cavity above a finished ceiling.
   3. Penetrations of a wall or partition dividing one unfinished space from another unfinished space, such as service spaces, storage rooms, and equipment rooms.
C. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening. Use one-piece type for new piping and split-plate type for existing piping as specified in Part 2 of this section.

D. Install floor plates for piping penetrations of unfinished floors in service spaces and equipment rooms. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening. Use one-piece floor-plate type for new piping and split-casting floor-plate type for existing piping as specified in Part 2 of this section.

E. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.

F. Cut sleeves to length for mounting flush with both surfaces. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

G. Fire-Resistance Rated, Cast-in-Place Sleeve Installation: Select sleeve size based on size and type of pipe and thickness of the floor. Position and secure sleeve to concrete form using nails or staples. Place concrete, and finish even with top of sleeve. Install in complete and strict accordance with manufacturer’s UL-listed installation instructions.

H. Build sleeves into new walls and slabs as work progresses.

I. Install sleeves large enough to provide ¼-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

1. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS (DN150).
2. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section “Flashing and Sheet Metal” for flashing.
3. Seal space outside of sleeve fittings with non-shrink, non-metallic grout.

J. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Refer to Division 07 Section “Joint Sealants” for materials. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.

K. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and modular sleeve seals. Size sleeve for 1-inch (25-mm) annular clear space between pipe and sleeve for installing modular sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron “wall pipes” for sleeves 6 inches (150 mm) in diameter and larger.
3. Assemble and install modular sleeve seals according to manufacturer’s written instructions. Tighten bolts that cause rubber-sealing elements to expand and make watertight seal.

L. Sleeves are not required for core-drilled holes.

M. Permanent sleeves are not required for holes formed by PE removable sleeves.

N. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials. Refer to Division 07 Section “Penetration Firestopping” for materials.

3.05 EQUIPMENT INSTALLATION REQUIREMENTS

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. Refer to equipment specifications in Division 23 and Division 26 for rough-in requirements.
B. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.

C. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.

D. Positive attachment and anchorage of all equipment to the structure or floor is required. Do not rely on friction or gravity as a means of attachment.

E. Install flexible pipe connectors at the following locations. Install on equipment side of shutoff valves.
   1. Where indicated elsewhere in these specifications.
   2. Where detailed on the Drawings.

F. Support for Suspended Equipment: As specified in Division 23 Section “Hangers and Supports.”

3.06 LABELING AND IDENTIFYING

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow. Use plastic markers, with application systems. Install on insulation segment if required for hot, uninsulated piping.

B. Locate pipe markers as follows if piping is exposed in finished spaces, machine rooms, and accessible maintenance spaces, such as shafts, tunnels, plenums, and exterior non-concealed locations:
   1. Near each valve and control device.
   2. Near each branch, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, if flow pattern is not obvious.
   3. Near locations where pipes pass through walls, floors, ceilings, or enter non-accessible 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 of 50-foot (15-m) intervals along each run. Reduce intervals to 25 feet (7.5 m) in congested areas of piping and equipment.
   7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

C. Install continuous plastic underground warning tapes during back filling of trenches for underground piping. Locate 6 to 8 inches (150 to 200 mm) below finished grade, directly over piping. Refer to Division 31 Section “Earth Moving” for warning-tape materials and devices and their installation.

D. Equipment: Install engraved plastic-laminate sign on or near each major item of mechanical equipment.
   1. Lettering Size: Minimum ¼-inch- (6.4-mm-) high lettering for name of unit if viewing distance is less than 24 inches (610 mm), ½-inch- (12.7-mm-) high lettering for distances up to 72 inches (1800 mm), and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
   2. Text of Signs: Provide name of identified unit. Include text to distinguish between multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

E. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers showing duct system service and direction of flow. In each space, if ducts are exposed or concealed by removable ceiling system, locate signs near points where ducts enter into space and at maximum intervals of 50 feet (15 m).
F. Adjusting: Relocate identifying devices as necessary for unobstructed view in finished construction.

G. Install valve tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, faucets, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units.

3.07 PAINTING AND FINISHING

A. For all painting and finishing work required for mechanical installations, refer to Division 09 Sections for application requirements.

3.08 CONCRETE BASES

A. Anchor equipment to concrete base according to equipment manufacturer’s written instructions.

B. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.

C. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.

D. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

E. Place and secure anchorage devices. Use supported equipment manufacturer’s setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

F. Install anchor bolts according to anchor-bolt manufacturer’s written instructions. Install anchor bolts to elevations required for proper attachment to supported equipment.

G. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03.

3.09 COORDINATION WITH STRUCTURAL WORK

A. Concrete: Do not embed pipes, wires, tube, boxes, ducts or other cavity-creating elements in concrete work unless shown on or permitted by the structural drawings. Openings through concrete not shown on the structural drawings are subject to approval by the structural engineer of record. See coordination drawing requirements under Submittals.

B. Roof Deck: Do not place loads on, or hang any loads whatsoever from roof deck, unless shown on structural drawings, including, but not limited to, hangers for pipes, ducts, equipment, etc. Trade contractor installing such loads shall provide sub-framing connected to steel frame.

1. Do not exceed capacity of roof deck as a working platform. Submit all proposed construction loads to deck supplier for approval.

2. Openings in roof deck not shown on structural drawings, such as openings required for stacks, pipes,ducts, plumbing vents, etc., shall be cut and reinforced by trade requiring opening.

C. Supported Slab: Do not suspend loads exceeding 500 pounds within any 100 square feet of contiguous area from concrete supported slab. Suspend such loads from structural steel only. Any “sub-framing” required is responsibility of Contractor or sub-contractor installing material requiring support.

1. Openings in concrete floor slabs not shown on structural drawings, such as openings required for stacks, pipes, ducts, plumbing vents, etc., shall be the responsibility of the trade requiring openings. Form blockouts in the slab, reinforcing deck, and cut openings after concrete has reached specified strength.
2. Where openings larger than 12-inches are required but not shown on structural drawings, secure written approval from Architect/Engineer prior to cutting deck.

3.10 SELECTIVE DEMOLITION

A. Disconnect, demolish, and remove mechanical work as indicated on the Drawings, and as required for installation of new work shown. Coordinate with Division 26 for disconnection of power to electrically-powered equipment prior to demolition.

B. Remove accessible work in its entirety. Repair cut surfaces to match adjacent surfaces. Abandon in place embedded or buried work, unless noted otherwise.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

2. Equipment to Be Removed: Disconnect and cap services and remove equipment.

C. Removal: Unless otherwise indicated, remove demolished pipe, duct and equipment from the Project site. Handle and dispose of in accordance with National, State, and Local regulations.

1. Relocation: Remove, store, clean, reinstall, reconnect, and make operational all work indicated for relocation.

2. Salvage: Remove and deliver to Owner all work indicated for salvage.

D. Refer to Division 01 Sections “Selective Demolition” and/or “Selective Structure Demolition” for additional requirements.

E. For selective demolition of any appliance or piece of equipment containing a CFC, HCFC, or HFC refrigerant: Prior to demolition, refrigerant shall be evacuated and captured in full compliance with the Clean Air Act; using only technicians with the proper refrigerant license as according to law, stored in approved containers, and shipped to a licensed refrigerant recycling facility all as required by the United States Environmental Protection Agency.

3.11 CUTTING AND PATCHING

A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay. Perform cutting and patching in accordance with the following:

B. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

C. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.

2. Remove and replace defective Work.

3. Remove and replace Work not conforming to requirements of the Contract Documents.

4. Install equipment and materials in existing structures.

D. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, pumps, and other mechanical items made obsolete by the new Work.

E. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.

F. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

G. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

H. Repair cut surfaces to match adjacent installations.
I. Repair any building insulation or building fireproofing materials, whether new or existing, that are removed or scraped away in order to make a mechanical installation, so as to maintain an equivalent insulation or fire rating as existed without said mechanical installation.

J. Refer to Division 01 Sections “Execution” and/or “Cutting and Patching” for additional requirements.

END OF SECTION 230500
PART 1 - GENERAL

1.01 SUMMARY
A. This Section includes basic requirements for factory-installed motors associated with mechanical equipment specified elsewhere in Division 23.

B. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer’s factory or shipped separately by equipment manufacturer for field installation.

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

B. Section 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “Basic Mechanical Materials and Methods” all apply to the work of this Section as if fully repeated herein.

C. Related Sections include all other Division 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.03 DEFINITIONS
A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

B. ODP: Open drip-proof.

C. TEAO: Totally-enclosed, air-over.

D. TEFC: Totally-enclosed, fan-cooled.

1.04 SUBMITTALS
A. Product Data: Submit motor product data with each associated equipment submittal. Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.

1.05 QUALITY ASSURANCE
A. Comply with NFPA 70.

B. UL Listing: Motors specified in this Section must be listed and labeled by Underwriters Laboratories and bear the UL logo.

1.06 COORDINATION
A. Coordinate features of motors, installed units, and accessory devices and features that comply with the following:
   1. Compatible with magnetic controllers, multi-speed controllers, and/or reduced-voltage controllers where applicable.
   2. Designed and labeled for use with variable frequency controllers where applicable and suitable for use throughout speed range without overheating.
   3. Matched to torque and horsepower requirements of the load.
   4. Matched to ratings and characteristics of supply circuit and required control sequence.

B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.
PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Subject to compliance with requirements, provide motors by one of the following:
   1. Baldor Electric Co.
   2. Century Electric Co.
   4. MagneTek
   7. Siemens Energy & Automation, Inc.

2.02 BASIC MOTOR REQUIREMENTS
A. Basic requirements apply to all types of mechanical equipment motors, unless otherwise indicated.
   1. Motors ½ HP and Larger: Polyphase.
   3. Frequency Rating: 60 Hz.
B. Voltage Rating: NEMA standard voltage selected to operate on nominal voltage of circuit to which motor is connected.
C. Service Factor: According to NEMA MG 1, unless otherwise indicated, but at least 1.15 for polyphase motors and 1.35 for single-phase motors.
D. Duty: Continuous duty at ambient temperature of 104°F (40°C) and at altitude of 3300 feet (1000 meters) above sea level.
E. Capacity and Torque Characteristics: Rated for continuous duty and sufficient to start, accelerate, and operate connected loads at designated speeds, in indicated environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
F. Enclosure: ODP, unless otherwise indicated.

2.03 POLYPHASE MOTORS
A. Description: NEMA MG 1, Design E, medium induction motor, unless otherwise indicated.
   1. Stator: Copper windings, unless otherwise indicated.
   2. Rotor: Random-wound, squirrel cage, unless otherwise indicated.
   3. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
   4. Temperature Rise: Match insulation rating, unless otherwise indicated.
   5. Insulation: Class F, unless otherwise indicated.
B. Enclosure: Cast iron for motors 7½ HP and larger; rolled steel for motors smaller than 7½ HP; with enamel finish.
C. Efficiency: Motor efficiencies for motors one horsepower and greater shall in no case be less efficient than “Premium Efficiency” as defined in NEMA MG 1-2014 Motors and Generators. Motors shall be tested and labeled in accordance with NEMA MG 1-2014 Standard. Motor nameplate labeling shall include both the minimum and nominal efficiency.
D. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
E. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Designed with critical vibration frequencies outside operating range of controller output.
2. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
3. Temperature Rise: Matched to rating for Class B insulation.
4. Insulation: Class F or H.
5. Motor shall be inverter-duty or inverter-ready and shall not require the use of external cooling fans.

F. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

G. Source Quality Control: Perform the following routine tests according to NEMA MG 1:
   1. Measurement of winding resistance.
   2. No-load readings of current and speed at rated voltage and frequency.
   3. Locked rotor current at rated frequency.
   4. High-potential test.
   5. Alignment.

2.04 SINGLE-PHASE MOTORS

A. Type: As indicated or selected by manufacturer from one of the following, to suit starting torque and other requirements of specific motor application.
   1. Permanent-split capacitor.
   2. Split-phase start, capacitor run.
   3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: Do not use, unless motors are smaller than 1/20 hp.

C. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

D. Thermal Protection: Where indicated or required, internal protection shall automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device shall automatically reset when motor temperature returns to normal range, unless otherwise indicated.

E. Bearings: Ball-bearing type for belt-connected motors and other motors with high radial forces on motor shaft. Sealed, pre-lubricated sleeve bearings for other single-phase motors.

2.05 ELECTRICALLY-COMMUTATED MOTORS

A. General: Electrically-Commutated Motors (ECM) are required wherever indicated in other Division 23 Specifications and/or notations on the Drawings.

B. Motor: Motor shall be ECM, variable-speed, DC type, brushless motor designed for fan applications with heavy duty permanently lubricated ball bearings and electric commutation. It shall contain internal circuitry that converts single phase power into a DC signal. Motor shall be designed for direct-drive applications.

C. Speed Control: The ECM shall be speed-controllable down to 10% of full speed via exterior-mounted field-adjustable potentiometer dial or DDC control signal input.

D. Efficiency: Minimum 70% at all speeds.

E. Voltage: Single-phase 115-V or 277-V as indicated.

F. Rotor: Synchronous; permanent magnet type; built-in soft start.

G. Thermal Protection: Where indicated or required, internal protection shall automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device shall automatically reset when motor temperature returns to normal range, unless otherwise indicated.
PART 3 - EXECUTION

3.01 INSTALLATION, ALL MOTORS

A. Use adjustable motor mounting bases for belt-driven motors. Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer’s written instructions. Verify bearing lubrication.

B. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load. Test interlocks and control and safety features for proper operation. Verify that current and voltage for each phase comply with nameplate rating and NEMA MG 1 tolerances.

C. Correct malfunctioning motors on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new motors and retest.

END OF SECTION 23 0513
PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
   1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
   2. Adjusting total HVAC systems to provide indicated quantities.
   4. Reporting results of the activities and procedures specified in this Section.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “Basic Mechanical Materials and Methods” all apply to the work of this Section as if fully repeated herein.
C. The following Sections contain requirements that relate to this Section:
   1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
   2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.03 DEFINITIONS

D. SMACNA: Sheet Metal and Air Conditioning Contractors’ National Association.

1.04 SUBMITTALS

A. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

1.05 QUALITY ASSURANCE

A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB.
B. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports.
D. Instrumentation Type, Quantity, and Accuracy: As described in AABC National Standards for Total System Balance, 7th Edition or in NEBB’s “Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems,” Section II, “Required Instrumentation for NEBB Certification” except where more stringent requirements are specified in this Section.
E. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.06 PROJECT CONDITIONS
A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire testing, adjusting, and balancing period. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner’s operations.

1.07 COORDINATION
A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
B. Notice: Provide 7 days’ advance notice for each test. Include scheduled test dates and times.
C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 EXAMINATION
A. Examine Contract Documents to become familiar with project requirements.
B. Examine approved submittal data of HVAC systems and equipment.
C. Examine equipment performance data, including fan and pump curves.
D. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
E. Examine air-handling equipment to ensure clean filters have been installed.
F. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible.
G. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.02 PREPARATION
A. Before beginning testing, adjusting and balancing, verify the following:
   1. Permanent electrical power wiring is complete.
   2. Automatic temperature-control systems are operational.
   3. Equipment and duct access doors are securely closed.
   4. Balance dampers are open.
   5. Isolating and balancing valves are open and control valves are operational.
   6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
   7. Windows and doors can be closed so design conditions for system operations can be met.

3.03 TESTING AND BALANCING PROCEDURES
A. Perform testing and balancing procedures on each system according to the procedures contained in AABC National Standards for Total System Balance, 7th Edition or NEBB’s “Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems” except where more stringent requirements are specified in this Section.
B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. Set HVAC system airflow within the following tolerances:
   1. Supply, Return, and Exhaust Fans: Plus or minus 5 percent.
   2. Air Outlets and Inlets: Plus or minus 10 percent.

3.04 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer. Include a list of the instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to the certified field report data, include pump curves and fan curves.

D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
   1. Title page.
   2. Name and address of testing, adjusting, and balancing Agent.
   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 testing, adjusting, and balancing Agent who certifies the report.
   10. Summary of contents, including design versus final performance, notable characteristics of systems, and description of system operation sequence if it varies from the Contract Documents.
   11. Nomenclature sheets for each item of equipment.
   12. Data for terminal units, including manufacturer, type size, and fittings.
   13. Notes to explain why certain final data in the body of reports vary from design values.
   14. Test conditions for fans and pump performance forms.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems with a keyed identification system for each device.

F. Air-Handling Unit Test Reports.

G. Apparatus-Coil Test Reports: For all air handling unit coils.

H. Fan Reports: For all supply, return, and exhaust fans.

I. Duct Traverse Reports.

J. Air-Terminal-Device Reports: For each terminal unit, air inlet, and air outlet.

K. System-Coil Reports: For all reheat coils and water coils of terminal units.
L. Instrument Calibration Reports: For instrument calibration, include instrument type and make, serial number, application, dates of use, and dates of calibration.

END OF SECTION 23 0593
SECTION 23 0700
MECHANICAL INSULATION

PART 1 - GENERAL
1.01 SUMMARY
A. This Section includes mechanical insulation for ductwork, piping, appliance breechings and other installations, including the following:
1. Insulation Materials: Flexible elastomeric and mineral fiber.
2. Insulating cements, adhesives, mastics, and sealants.
3. Field-applied jackets.
4. Tapes and securements.

1.02 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “Basic Mechanical Materials and Methods” all apply to the work of this Section as if fully repeated herein.
C. The following Sections contain requirements that relate to this Section:
1. Division 23 Section “Metal Ducts” for internal duct liners.

1.03 DEFINITIONS
A. ASJ: All-service jacket.
B. FSK: Foil, scrim, kraft paper.
C. SSL: Self-sealing lap.
D. Thermal Resistivity: “R-values” represent the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1-inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between two exposed faces required to cause one BTU to flow through one square foot of material, in one hour, at a given mean temperature.
E. VOC: Volatile Organic Compound as defined by LEED v4 Credit EQc2.
F. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
G. Exposed Installations: Exposed to view. Examples include finished occupied spaces without ceilings, mechanical equipment rooms, courtyards and rooftop locations.
H. Concealed Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings or within duct shafts.
I. Conditioned Space: Spaces that are served by both a mechanical heating and mechanical cooling system are conditioned spaces. Heating-only spaces are not conditioned spaces. The space above a ceiling is considered conditioned space if the space directly below that ceiling is conditioned space. A vertical shaft is considered conditioned space if the spaces on all sides surrounding the shaft are conditioned spaces.

1.04 SUBMITTALS
A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).
B. MSDS (Material Safety Data Sheet) for each adhesive, mastic, sealant, and cement furnished.
1.05 QUALITY ASSURANCE
A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
B. Fire-Test-Response Characteristics: Insulation and related materials shall have flame-spread index of 25 or less, and smoke-developed index of 50 or less, as determined by testing identical products per ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.07 COORDINATION
A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section “Hangers and Supports.”
B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
C. Coordinate installation and testing of heat tracing.

1.08 SCHEDULING
A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS
2.01 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
   1. Flexible Elastomeric Insulation:
      a. Aeroflex USA Inc.; Aerocel.
      b. Armacell LLC; AP/Armaflex.
      c. K-Flex USA; Insul-Lock® Seam-Seal.
      d. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
   2. Mineral Fiber Insulation:
      a. CertainTeed Corp.
      b. Johns Manville.
      c. Knauf Insulation.
      d. Manson Insulation Inc.
      e. Owens Corning.
   3. Insulating Cements: Same as insulation manufacturer, or
      a. Insulco, Division of MFS, Inc.

4. Sealants, Adhesives and Mastics: Same as insulation manufacturer, or
   a. H.B. Fuller Construction Products Inc. (Childers and/or Foster brands)
   b. ITW TACC, Division of Illinois Tool Works.
   c. Marathon Industries, Inc.
   d. Mon-Eco Industries, Inc.
   e. Vimasco Corporation.

5. Field-Applied Jackets: Same as insulation manufacturer, or
   a. P.I.C. Plastics, Inc.
   b. PABCO Metals Corporation.
   c. Pittsburgh Corning Corporation.
   d. Polyguard Products, Inc.
   e. Proto PVC Corporation.
   f. RPR Products, Inc.
   g. Speedline Corporation.

6. Tapes: Same as insulation manufacturer, or
   a. Avery Dennison Corporation, Specialty Tapes Division.
   b. Compac Corp.
   c. Ideal Tape Co., Inc., an American Biltrite Company.
   d. Polyguard Products, Inc.
   e. Venture Tape.

7. Bands and Wire: Same as insulation manufacturer, or
   a. ACS Industries, Inc.
   b. C & F Wire.
   c. Childers Products.
   d. PABCO Metals Corporation.
   e. RPR Products, Inc.

8. Insulation Pins and Hangers: Same as insulation manufacturer, or
   a. AGM Industries, Inc.
   b. GEMCO.
   c. Midwest Fasteners, Inc.

2.02 INSULATION MATERIALS

A. Refer to Schedule in Part 4 for requirements about where insulating materials shall be applied.

B. Restrictions: Products shall not contain asbestos, lead, mercury, or mercury compounds. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

C. Adhesives shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

D. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type I for tubular materials and Type II for sheet materials.
   1. Thermal Conductivity: 0.28 average maximum at 75ºF mean temperature using test method ASTM C177 or C518.
   2. Water Vapor Permeability: Maximum 0.1 perm-inch using test method ASTM E96 Procedure A.
   3. Water Absorption: Maximum 0.2% by volume using test method ASTM C209.

5. Adhesive: Comply with MIL-A-24179A, Type II, Class I; VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type III with factory-applied jacket.
   1. Thermal Conductivity: 0.26 average maximum at 75°F mean temperature.
   2. Density: 1.5 lb/ft³ (24-kg/cu. m) minimum.
   3. Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB.
   1. Thermal Conductivity: 0.26 average maximum at 75°F mean temperature.
   2. Density: 2.0 lb/ft³ (32-kg/cu. m) minimum.
   3. Jacket (Ducts): Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
   4. Jacket (Equipment): White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.

2.03 CEMENTS AND MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Insulating Cements: Select one or more of the following at contractor’s option.
   2. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.

C. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below-ambient services. Equal to Foster 30-33 or Childers CP-33 or Vimasco 749.
   1. Water-Vapor Permeance: ASTM E96, Procedure B, 0.07 perms or less at 41 mil dry film thickness.
   2. Service Temperature Range: -20 to +180°F (-29 to +82°C).

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services. Equal to Foster 46-50 or Childers CP-10/11 or Vimasco WC-5.
   1. Water-Vapor Permeance: ASTM F1249, 3 perms (2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
   2. Service Temperature Range: -20 to +200°F (-29 to +93°C).
   3. Solids Content: 63 percent by volume and 73 percent by weight.

2.04 SEALANTS

A. Joint Sealants: Permanently flexible, elastomeric sealant. Materials shall be compatible with insulation materials, jackets, and substrates.
   1. Service Temperature Range: -100 to +200°F (-73 to +94°C).
   2. Color: White, tan, or gray.
   3. VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants: Fire- and water-resistant, flexible, elastomeric sealant. Materials shall be compatible with insulation materials, jackets, and substrates.
   1. Service Temperature Range: -40 to +250°F (-40 to +121°C).
   2. Color: Aluminum.
3. VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants: Fire- and water-resistant, flexible, elastomeric sealant. Materials shall be compatible with insulation materials, jackets, and substrates.
   1. Service Temperature Range: -40 to +250°F (-40 to +121°C).
   3. VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.05 FIELD-APPLIED JACKETS
A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.
B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness 30 mils (0.8 mm); roll stock ready for shop or field cutting and forming.
   1. Adhesive: Compatible with PVC, as recommended by jacket material manufacturer.
   3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
   4. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
   5. Factory-fabricated tank heads and tank side panels.
C. Metal Jackets: Sheet and roll stock ready for shop or field sizing. Factory pre-cut and rolled to size is also acceptable.
   1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105 or 5005, Temper H-14. Finishes and thickness as follows:
      a. Indoor Ducts and Plenums: Smooth, 0.016-inch (0.41 mm) thick.
      b. Indoor Equipment: Stucco Embossed, 0.016-inch (0.41 mm) thick.
      c. Outdoor Ducts, Equipment, and Piping: Stucco embossed, with Z-shaped locking seam, 0.024-inch (0.61 mm) thick.
   2. Stainless-Steel Jacket: ASTM A167 or ASTM A240; Type 304 stucco embossed, with Z-shaped locking seam; 0.016-inch (0.41 mm) thick.
   3. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
   4. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
   5. Factory-Fabricated Fitting Covers: Same material, finish, and thickness as jacket; provide as required for preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows, tee covers, flange and union covers, end caps, beveled collars, and valve covers.
   6. Field-fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.06 TAPES
A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136 and UL listed.
   1. Width: 3-inches (75 mm).
   2. Thickness: 11.5 mils (0.29 mm).
   3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
   4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch (7.2 N/mm) 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 C1136 and UL listed.
   1. Width: 3-inches (75 mm).
   2. Thickness: 6.5 mils (0.16 mm).
   3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
   6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
   1. Width: 2-inches (50 mm).
   2. Thickness: 6 mils (0.15 mm).
   3. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
   4. Elongation: 500 percent.
   5. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.
   1. Width: 2-inches (50 mm).
   2. Thickness: 3.7 mils (0.093 mm).
   3. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
   4. Elongation: 5 percent.
   5. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.07 SECUREMENTS

A. Bands:
   1. Stainless Steel: ASTM A167 or ASTM A240, Type 304; 0.015-inch (0.38 mm) thick, ½-inch (13 mm) wide with wing or closed seal.
   2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch (0.51 mm) thick, ½-inch (13 mm) wide with wing or closed seal.

B. Insulation Pins and Hangers:
   1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
   2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1½-inch (38-mm) galvanized carbon-steel washer.
   3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch (0.41-mm) thick, aluminum or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1½-inches (38 mm) in diameter. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal ¾-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.
PART 3 - EXECUTION

3.01 EXAMINATION
A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application. Verify that systems and equipment to be insulated have been tested and are free of defects. Verify that surfaces to be insulated are clean and dry. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION
A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 COMMON INSTALLATION REQUIREMENTS
A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Install insulation with longitudinal seams at top and bottom of horizontal runs. Install multiple layers of insulation with longitudinal and end seams staggered.
E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
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. Install insulation with least number of joints practical.
H. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
I. Apply adhesives, mastics, and sealants at manufacturer’s recommended coverage rate and wet and dry film thicknesses.
J. 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 1½-inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2-inches (50 mm) o.c.
4. For below ambient services, apply vapor-barrier mastic over staples.
5. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
M. 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.
N. At the following locations, omit jacket and provide a separate cutaway removable segment of insulation clearly labeled "Access." For below-ambient services, provide a design that allows access but maintains vapor barrier.
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.
   5. Handholes.
   6. Cleanouts.

3.04 PENETRATIONS
A. 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.
B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

3.05 DUCT INSULATION INSTALLATION
A. See Part 4 Insulation Schedules for specific requirements.
B. The following ductwork items need not be insulated, unless noted otherwise:
   1. Factory-insulated plenums, casings, fan housings, and air terminal units.
   2. Flexible connectors.
   4. Factory-insulated access panels and doors.
C. Secure all insulation on ducts and plenums with insulation pins. 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:
   1. On duct sides with dimensions 18-inches (450 mm) and smaller, pins may be omitted.
2. On duct sides with dimensions 18-inches (450 mm) and larger, place pins along longitudinal centerline of duct. Space 3-inches (75 mm) maximum from insulation end joints, and 16-inches (400 mm) o.c.

3. On duct sides with dimensions larger than 36-inches (900 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.

4. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

5. Do not over-compress insulation during installation.

6. If using blanket insulation, impale insulation over pins and attach speed washers.

7. 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.

D. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2-inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with ½-inch (13-mm) outward-clinching staples, 1-inch (25 mm) o.c. Complete the vapor barrier by applying FSK tape specified in Part 2, or vapor-barrier mastice and sealant, at all joints, seams, and protrusions.

1. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

2. Install vapor stops for ductwork and plenums operating below 50ºF (10 C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastice applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3-inches (75 mm).

E. If using blanket insulation, 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.

F. Unless factory-insulated, install duct insulation continuously and unbroken over duct-mounted accessories such as fans, coils, terminal units, humidifier housings, damper housings, airflow measuring station housings, etc.

G. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. If using board insulation, groove and score insulation to fit as closely as possible to outside and inside radius of elbows.

H. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

I. 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.

3.06 PIPE INSULATION INSTALLATION

A. See Part 4 Insulation Schedules for specific requirements.

B. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

C. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. If furnished in half sections, orient longitudinal joints at 3 and 9 o’clock positions on the pipe.

2. All insulation shall be tightly butted and free of voids and gaps at all joints.

3. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastice and joint sealant.
4. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6-inches (150 mm) o.c.
5. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant. Vapor barrier must be continuous.

D. Insulation Installation on Pipe Flanges or Mechanical Couplings:
1. Install preformed pipe insulation to outer diameter of pipe flange or mechanical coupling (such as grooved pipe couplings, if applicable).
2. Make width of insulation section same as overall width of flange/coupling and bolts, plus twice the thickness of pipe insulation, not to exceed 1½-inch (38-mm) thickness.
3. Fill voids between inner circumference of flange/coupling insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1-inch (25 mm), and seal joints with flashing sealant.

E. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
3. Cut sectional pipe insulation to fit. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

F. Insulation Installation on Valves, Strainers, Unions, and Specials:
1. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation over valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
4. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
5. Insulate unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
6. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
7. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

8. Stencil or label the outside insulation jacket of each union with the word “UNION.” Match size and color of pipe labels.

G. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

H. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2-inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

I. Special Requirements for Flexible Elastomeric Insulation Installation: Seal all transverse seams, longitudinal seams, end joints, and section joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.07 FIELD-APPLIED JACKET INSTALLATION

A. See Part 4 Insulation Schedules for specific requirements.

B. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. 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.

3.08 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
**PART 4 - SCHEDULES**

**4.01 INSULATION SCHEDULES**

A. Furnish and install duct, equipment, and piping insulation as specified above and in accordance with the schedules below. All insulation thicknesses and pipe sizes in the following tables are given in nominal inches. Where more than one type of allowable material or more than one type of field jacket is listed, the choice is contractor’s option.

B. Hot Surfaces: For piping, ductwork, and equipment services denoted as 105ºF or greater, all piping surfaces including but not limited to pipe, duct, flanges, fittings, valves of every kind, pumps, dampers, strainers, unions, steam traps, and other appurtenances shall be insulated to avoid potential for personnel injury via contact with hot surface.

C. Cold Surfaces: For piping, ductwork, and equipment surfaces operating below surrounding ambient temperature, all surfaces including but not limited to pipe, duct, flanges, fittings, valves of every kind, pumps, dampers, strainers, unions, and other appurtenances shall be insulated and shall include uninterrupted vapor barrier to avoid potential condensation.

### DUCT INSULATION

<table>
<thead>
<tr>
<th>Service</th>
<th>Duct Location</th>
<th>Minimum R-Value</th>
<th>Allowable Materials</th>
<th>Insulation Thickness</th>
<th>Field Jacket</th>
<th>Keyed Notes</th>
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<td><strong>Supply Air Service</strong></td>
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<tr>
<td>(including outdoor air that has been heated or cooled)</td>
<td>Round, Oval</td>
<td>ICC,ICN</td>
<td>R-3.5</td>
<td>FGBK</td>
<td>1.50</td>
<td>AL</td>
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<td>R-8</td>
<td>FGBK,FE</td>
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<td>AL,SS</td>
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<tr>
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<td></td>
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<tr>
<td></td>
<td>Round, Oval</td>
<td>ICC,ICN</td>
<td>R-3.5</td>
<td>FGBK</td>
<td>1.50</td>
<td>---</td>
</tr>
<tr>
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<td></td>
<td>IEC,IEN</td>
<td>R-3.5</td>
<td>FGBD</td>
<td>1.50</td>
<td>---</td>
</tr>
<tr>
<td></td>
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<td>FGBD,FE</td>
<td>2.00</td>
<td>AL,SS</td>
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</tr>
<tr>
<td><strong>Outdoor Air Service</strong></td>
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<tr>
<td>(prior to being heated or cooled)</td>
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<td>R-3.5</td>
<td>FGBK</td>
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<tr>
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<td>AL</td>
</tr>
<tr>
<td></td>
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<td>Round, Oval</td>
<td>ICC,ICN</td>
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<tr>
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<tr>
<td><strong>Exhaust Air Service</strong></td>
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<td>Round, Oval</td>
<td>ICC, IEC</td>
<td>R-3.5</td>
<td>FGBK</td>
<td>1.50</td>
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<td>ICN, IEN</td>
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<td>(1) (5)</td>
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<tr>
<td>Outdoors</td>
<td>R-8</td>
<td>FGBD,FE</td>
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<td>---</td>
<td>CS</td>
<td>4.00</td>
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</table>

**KEYED NOTES:**

1. Insulate only if the exhaust is routed to an energy-recovery device.
2. Insulate only between final isolation damper and penetration of building exterior.
3. The specified field jacket is required only if less than 84-inches AFF.
4. For boilers, furnaces, water heaters, and engine exhaust, if not factory-insulated.
5. Omit insulation if duct is expressly called out to be internally lined.
6. Thickness as required to achieve 2-hour fire rating.

**LEGEND:**

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<thead>
<tr>
<th>Code</th>
<th>Description</th>
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</tr>
<tr>
<td>ICN</td>
<td>Indoor, Concealed, in Non-conditioned space</td>
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<tr>
<td>CS</td>
<td>Calcium Silicate</td>
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<tr>
<td>FRW</td>
<td>Fire-Rated Wrap</td>
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<tr>
<td>PIPE INSULATION</td>
<td>Temperature Range °F</td>
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<tr>
<td>-----------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Equipment drains</td>
<td>below 60</td>
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<tr>
<td>Refrigerant suction and hot gas piping</td>
<td>All</td>
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<tr>
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</tbody>
</table>

KEYED NOTES:

1. Insulate condenser water piping only if used as part of a water-side economizer, or if freeze-protected (e.g., heat-traced) outdoors.
2. The specified field jacket is required only if outdoors.
3. The specified field jacket is required on fittings only.

LEGEND:

<table>
<thead>
<tr>
<th>AFF</th>
<th>FE</th>
<th>MF</th>
<th>SCR</th>
<th>PVC</th>
<th>CG</th>
<th>PI</th>
<th>AL</th>
<th>HW</th>
<th>SS</th>
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<td>Mineral Fiber</td>
<td>Steam Condensate Return</td>
<td>Polyvinyl Chloride</td>
<td>Cellular Glass</td>
<td>Polyisocyanurate</td>
<td>Aluminum</td>
<td>Hot Water</td>
<td>Stainless Steel</td>
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</tbody>
</table>

END OF SECTION 23 0700
PART 1 - GENERAL

1.01 SUMMARY
A. This Section includes refrigerant piping used for air-conditioning applications.

1.02 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary
   Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “Basic
   Mechanical Materials and Methods” all apply to the work of this Section as if fully repeated
   herein.

1.03 PERFORMANCE REQUIREMENTS

1.04 SUBMITTALS
A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include
   pressure drop, based on manufacturer's test data, for the following:
   1. Thermostatic expansion valves.
   2. Solenoid valves.
   3. Filter dryers.
   4. Strainers.
   5. Pressure-regulating valves.
B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and
   fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs,
   oil traps, double risers, wall and floor penetrations, and equipment connection details.
   Show interface and spatial relationships between piping and equipment.
   1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design
      actual piping layout, including oil traps, double risers, specialties, and pipe and
      tube sizes to accommodate, as a minimum, equipment provided, elevation
      difference between compressor and evaporator, and length of piping to ensure
      proper operation and compliance with warranties of connected equipment.
C. Field quality-control test reports.
D. Operation and Maintenance Data: For refrigerant valves and piping specialties to include
   in maintenance manuals.

1.05 QUALITY ASSURANCE
A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel
   Code: Section IX, “Welding and Brazing Qualifications.”
C. Comply with ASHRAE 34-2016 Designation and Safety Classification for Refrigerants.
D. Comply with ASME B31.5 Refrigeration Piping and Heat Transfer Components.
E. Comply with NFPA 70 – National Electrical Code.

1.06 PRODUCT STORAGE AND HANDLING
A. Store piping in a clean and protected area with end caps in place to ensure that piping
   interior and exterior are clean when installed.

1.07 COORDINATION
A. Coordinate size and location of equipment supports, and wall penetrations.
PART 2 - PRODUCTS

2.01 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.
B. Wrought-Copper Fittings: ASME B16.22.
C. Wrought-Copper Unions: ASME B16.22.
D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
E. Brazing Filler Metals: AWS A5.8.
F. Flexible Connectors:
   2. End Connections: Socket ends.
   3. Offset Performance: Capable of minimum ¾-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
   4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
   5. Maximum Operating Temperature: 250°F (121°C).

2.02 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:
   1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
   3. Operator: Rising stem and hand wheel.
   5. End Connections: Socket, union, or flanged.
   7. Maximum Operating Temperature: 275°F (135°C).

B. Packed-Angle Valves:
   1. Body and Bonnet: Forged brass or cast bronze.
   2. Packing: Molded stem, back seating, and replaceable under pressure.
   3. Operator: Rising stem.
   5. Seal Cap: Forged-brass or valox hex cap.
   6. End Connections: Socket, union, threaded, or flanged.

C. Check Valves:
   1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
   2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
   5. End Connections: Socket, union, threaded, or flanged.
   6. Maximum Opening Pressure: 0.50 psig (3.4 kPa).

D. Service Valves:
   1. Body: Forged brass with brass cap including key end to remove core.
   2. Core: Removable ball-type check valve with stainless-steel spring.
   4. End Connections: Copper spring.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
   4. End Connections: Threaded.
   5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with ½-inch (16-GRC) conduit adapter, and 24-V ac coil.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
   1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
   4. End Connections: Threaded.

G. Electronic Expansion Valves: Comply with ARI 750.
   4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
   5. Motor Type: 2 phase, bipolar wet motor.
   6. Supply Voltage: 12 volt DC, -5%, +10% measured at the valve leads.
   7. Cable Type: Hermetic.
   9. Phase Resistance: 100 ohms +/- 10%.
   10. Number of Steps: 2500.
   11. Operating Temperature: -50°F (-45°C) to 155°F (65°C)
   12. End Connections: Socket, flare, or threaded union.

H. Straight-Type Strainers:
   2. Screen: 100-mesh stainless steel.
   3. End Connections: Socket or flare.
   5. Maximum Operating Temperature: 275°F (135°C).

I. Angle-Type Strainers:
   1. Body: Forged brass or cast bronze.
   2. Drain Plug: Brass hex plug.
   3. Screen: 100-mesh monel.
   4. End Connections: Socket or flare.

J. Moisture/Liquid Indicators:
   2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
   3. Indicator: Color coded to show moisture content in ppm.
5. End Connections: Socket or flare.

K. Permanent Filter Dryers: Comply with ARI 730.
   2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
   5. Access Ports: NPS ¼ (DN 8) connections at entering and leaving sides for pressure differential measurement.
   6. Maximum Pressure Loss: 1 psig (0.07 bars).
   7. Rated Flow: 3.4 tons (11.9kW).

L. Mufflers:
   2. End Connections: Socket or flare.

M. Liquid Accumulators: Comply with ARI 495.
   2. End Connections: Socket or threaded.

2.03 REFRIGERANTS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Atofina Chemicals, Inc.
   2. DuPont Company; Fluorochemicals Div.
   3. Honeywell, Inc.; Genetron Refrigerants.
   4. INEOS Fluor Americas LLC.

B. Refrigerant R-410A is defined in ASHRAE Standard 34-2016.

PART 3 - EXECUTION
3.01 PIPING APPLICATIONS
A. Suction, Hot-Gas, and Liquid Lines: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints. Soldered joints will be acceptable for R-134a applications only.

B. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

3.02 VALVE AND SPECIALTY APPLICATIONS
A. Install valves in suction and discharge lines of compressor.
B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
D. Except as otherwise indicated, install valves on inlet and outlet side of filter dryers.
E. Install electronic expansion valves as close as possible to distributors on evaporators.
1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

F. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

G. 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.

H. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
   1. Solenoid valves.
   2. Electronic expansion valves.
   3. Compressor.

I. Install filter dryers in liquid line between compressor and electronic expansion valve, and in the suction line at the compressor.

J. Install receivers sized to accommodate pump-down charge.

K. Install flexible connectors at compressors.

3.03 PIPING INSTALLATION

A. 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 Shop Drawings.

B. Install refrigerant piping according to ASHRAE Standard 15-2016.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas. 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.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal. Install piping adjacent to machines to allow service and maintenance. Install piping free of sags and bends. Install fittings for changes in direction and branch connections.

E. Select system components with pressure rating equal to or greater than system operating pressure.

F. Refer to Division 23 Section “HVAC Instrumentation and Controls” for solenoid valve controllers, control wiring, and sequence of operation.

G. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

H. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section “Access Doors and Frames” if valves or equipment requiring maintenance is concealed behind finished surfaces.

I. Install refrigerant piping in protective conduit where installed belowground. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

J. 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.

K. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

L. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

M. Seal penetrations through fire and smoke barriers according to Division 07 Section “Through-Penetration Firestop Systems.”

N. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

O. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

P. Seal pipe penetrations through exterior walls according to Division 07 Section “Joint Sealants” for materials and methods.

Q. Identify refrigerant piping and valves according to Division 23 Section “Basic Mechanical Materials and Methods.”

3.04 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

B. Soldered Joints: Construct joints according to ASTM B 828 or CDA’s “Copper Tube Handbook.” Permitted only with R-134a piping systems.

C. Brazed Joints: Construct joints according to AWS’s “Brazing Handbook,” Chapter “Pipe and Tube.” Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.05 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products and spacing are specified in Division 23 Section “Hangers and Supports.”

3.06 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
   1. Comply with ASME B31.5, Chapter VI.
   2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
   3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 “Performance Requirements” Article. Fill system with nitrogen to the required test pressure. System shall maintain test pressure at the manifold gage throughout duration of test. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.07 SYSTEM CHARGING

A. Charge system using the following procedures:
   1. Install core in filter dryers after leak test but before evacuation.
   2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
   3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
   4. Charge system with a new filter-dryer core in charging line.
3.08 ADJUSTING

A. Adjust electronic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer’s written instructions:
   1. Open shutoff valves in condenser water circuit.
   2. Verify that compressor oil level is correct.
   3. Open compressor suction and discharge valves.
   4. Open refrigerant valves except bypass valves that are used for other purposes.
   5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300
PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes metal ducts and plenums for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg (minus 500 to plus 2500 Pa). Metal ducts include the following:
   1. Single-wall rectangular ducts and fittings.
   2. Sheet metal materials.
   3. Sealants and gaskets.
   4. Hangers and supports.

1.02 RELATED DOCUMENTS

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

B. The following Sections contain requirements that relate to this Section:
   1. Division 07 Sections “Penetration Firestopping” for fire-resistant sealants for use around duct penetrations and fire-damper installations in fire-rated floors, partitions, and walls.
   2. Division 08 Section “Access Doors and Frames” for wall- and ceiling-mounted access doors and for access to concealed ducts.
   3. Division 08 Section “Louvers and Vents” for intake and relief louvers and vents connected to ducts and installed in exterior walls.
   4. Division 23 Section “Mechanical Insulation.”
   5. Division 23 Section “Duct Accessories” for dampers, duct-mounting access doors and panels, and turning vanes.
   6. Division 23 Section “Diffusers, Registers and Grilles.”
   7. Division 23 Section “Testing, Adjusting and Balancing” for air balancing and final adjusting of manual volume dampers.

1.03 DEFINITIONS

A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C168.

1.04 PERFORMANCE REQUIREMENTS

A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by the design professional. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

B. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA HVAC Duct Construction Standards – Metal and Flexible and performance requirements and design criteria indicated in Part 3 of this Section.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2016.

1.05 SUBMITTALS

A. Product Data: For each type of the following products:
   1501 Creekwood Parkway - MU CP200101 / PWA 201918 23 3113 - 1
   Ambulance Base METAL DUCTS
1. Adhesives.
2. Sealants and gaskets.
3. Manufactured ductwork and duct fittings (if applicable).
4. MSDS (Material Safety Data Sheet) for each adhesive and sealant furnished.
5. Sheet metal thicknesses.
7. Reinforcement details and spacing.
8. Materials, fabrication, assembly, and spacing of hangers and supports.

1.06 QUALITY ASSURANCE


B. Comply with NFPA 96 *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations* for range hood ducts, unless otherwise indicated.


D. ASHRAE Compliance: Applicable requirements in ASHRAE Standard 90.1-2016, Section 6.4.4 – “HVAC System Construction and Insulation.”

1.07 REFERENCES


1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle sealant and firestopping materials according to manufacturer’s written recommendations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Field-Applied Duct Sealant Materials:
   
a. Ductmate, Inc.
   b. H.B. Fuller Construction Products Inc. (Childers and/or Foster brands)
   c. Hardcast, Inc.
   d. McGill Air Seal Corporation.

1501 Creekwood Parkway - MU CP200101 / PWA 201918 Ambulance Base 23 3113 - 2 METAL DUCTS
2. Optional Manufactured Duct Slide-on Flange System:
   a. Ductmate, Inc.
   b. Nexus Inc.
   c. Ward Industries, Inc.

2.02 SHEET METAL MATERIALS
A. General Material Requirements: Comply with SMACNA 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. Sheet Gage: SMACNA standards notwithstanding, no material thinner than 26-gage is permitted for spiral-seam round duct, and no material thinner than 24-gage is permitted for all other ducts.
C. Galvanized Sheet Steel: Comply with ASTM A653 / A653M.
   4. Minimum Thickness for Factory-Applied PVC Coating: 4 mils (0.10 mm) thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 2 mil (0.05 mm) thick on opposite surface.
   5. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.
D. Reinforcement Shapes and Plates: ASTM A36 / A36M, steel plates, shapes, and bars; black and galvanized. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
E. Tie Rods: Comply with Articles 2.5 through 2.9, including all accompanying Tables and Figures, of the SMACNA HVAC Duct Construction Standards.

2.03 SEALANT MATERIALS
A. Two-Part Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal; Hardcast® Two-Part Sealing System, Uni-Cast® by McGill AirSeal Corporation, or equal.
B. One-Part Sealing System: Flexible, adhesive sealant, fiber-reinforced, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts. Examples of acceptable products include Uni-Mastic 181 by McGill, Foster 32-19, and Childers CP-146.
C. Water-Based Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
D. Formed-on Duct Connectors: Flange shop roll-formed onto edge of ductwork, with corner closures, cleats and gaskets for seal; TDC or TDF constructed per SMACNA T-25a or T-25b.
   1. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use O.
   2. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.
   3. Contractor's Option: Proprietary manufactured slide-on duct connectors by Ductmate, Ward, or Nexus meeting the above requirements will be accepted wherever formed-on duct connectors are required by these specifications.
2.04 RECTANGULAR DUCT FABRICATION

A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA HVAC Duct Construction Standards – Metal and Flexible. Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, deflection limits, and joint types and intervals, except where more stringent requirements are specified herein.

B. All sheet metal shall be a minimum of 24-gage thickness in any case. Use 24-gage sheet metal where SMACNA allows thinner material.

C. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

D. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

E. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359-inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of unbraced panel area, unless ducts are lined.

F. Pressure Classification: See Schedule in Part 3 of this Section.

G. Seal Classification: See Schedule in Part 3 of this Section.

H. Longitudinal Seams: Contractor’s choice of Pittsburgh lock (SMACNA Figure 2-2 Type L-1) or Button Punch Snap Lock (SMACNA Figure 2-2 Type L-2) shall be used on all longitudinal seams. See “Seam and Joint Sealing” in Part 3 of this Section for further requirements.

I. Duct sizes shown on plans are actual sheet metal sizes and have been sized to account for the thickness of internal duct liner, if any.

J. Contractor is free to alter the indicated sizes of rectangular duct to suit field conditions, provided that revised size is selected for friction loss no greater than that of indicated size. No prior approval by the Engineer is required for equal-friction duct size changes unless proposed size has an aspect ratio greater than 4 to 1.

K. All changes of direction shall be fabricated as elbows in accordance with SMACNA Figure 4-2 except that RE-4, RE-9 and RE-10 are prohibited. RE-6 is limited to a change-of-direction angle of 45 degrees or less.

L. Divided flow branches shall be Type 1 or Type 2 per SMACNA Figure 4-5. Type 3 divided flow branches are permitted only where expressly shown. Seek Engineer’s approval of Type 3 where space and/or layout clearances prohibit Type 1 or Type 2.

M. Branch connections shall be per SMACNA Figure 4-6, except that straight taps are not permitted on any ducts 2-inch pressure class or above. Straight-tap “spin-in” fittings are permitted on ½-inch and 1-inch pressure class ductwork only.

N. Offsets and transitions shall be per SMACNA Figure 4-7, except that offset Type 2 (mitered) is limited to an angle of 45° or less.

O. Fittings at obstructions shall be per SMACNA Figure 4-8, except that Figure D is not permitted. Use Figure 4-8.B in lieu of Figure 4-8.D. Seek Engineer’s approval of Figure 4-8.D where space and/or layout clearances prohibit use of Figure 4-8.B.

2.05 SHOP- AND FIELD-FABRICATED PLENUMS

A. Description: Provide galvanized steel (unless noted otherwise) air plenums in accordance with Chapter 9 of SMACNA HVAC Duct Construction Standards – Metal and Flexible. Air plenums required for this project include:

1. Outdoor air intake plenums for attachment to exterior outdoor air intake louvers, with connection point(s) for outdoor air duct(s). Construction shall be single wall
with exterior insulation; coordinate size, orientation, and layout with Division 08 Section “Louvers and Vents” and the Drawings.

2. Exhaust air plenums for attachment to exterior exhaust louvers, with connection point(s) for exhaust air duct(s). Construction shall be single wall uninsulated; coordinate size, orientation, and layout with Division 08 Section “Louvers and Vents” and the Drawings.

3. Other HVAC plenums as indicated on Drawings.

B. Shop fabricate plenums to greatest extent possible with a minimum of joints and to minimize field fabrication and assembly.

C. Fabricate plenums with standing seam construction and angle reinforcement. Fabricate close-off sheets from plenum sides, top, and bottom to damper frames. Bolt close-off sheets to frame flanges and housings.

D. Fabricate plenums with sheet metal walls, top, and bottom panels. Do not use building walls, ceilings or floors as a portion of the plenum boundary, except where expressly shown on Drawings.

E. Reinforce plenums with galvanized or painted steel angles.

F. Seal joints as required in Part 3 of this Section.

G. Fabricate drain pans for air plenums adjacent to exterior louvers with external connection and vented deep-seal trap for drainage piping with a 3/4-inch (20-mm) pipe connection. Fabricate and reinforce drain pans of same material and thickness as housing, 2 inches (50 mm) deep with rolled edges. Solder seams.

H. Fabricate plenums with reinforced openings for access doors at least 20 inches (500 mm) wide by 48 inches (1200 mm) high and located for access to each item of equipment housed. Each plenum shall have at least one access door; more if shown on Drawings. Access doors shall swing out for negative pressure plenums and in for positive pressure plenums. Refer to Division 23 Section “Duct Accessories” for access doors.

PART 3 - EXECUTION

3.01 DUCT PRESSURE CLASS SCHEDULE

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

2. Outdoor Air Ducts: 2-inch wg (500 Pa), positive or negative pressure as applicable.
3. Return Ducts: 2-inch wg (500 Pa), positive or negative pressure as applicable.
4. Exhaust Ducts: 2-inch wg (500 Pa), positive or negative pressure as applicable.

3.02 DUCT MATERIAL SCHEDULE

A. All ducts shall be galvanized steel.

3.03 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA HVAC Duct Construction Standards – Metal and Flexible unless otherwise indicated.

B. Install ducts with fewest possible joints. Install fabricated fittings for changes in directions, size, and shape and for connections.
C. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12-inches (300 mm), with a minimum of 3 screws in each coupling.

D. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

E. Install ducts with a clearance of 1-inch (25 mm), plus allowance for insulation thickness.

F. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

G. Install duct accessories as required by Division 23 Section “Duct Accessories.”

H. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

I. Drawings are diagrammatic in nature. Not necessarily all fittings and offsets are shown. Provide all required fittings and offsets as required by field conditions and coordination with the work of other trades, whether specifically shown or not, for a complete and functional installation.

J. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

K. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

L. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1½ inches (38 mm).

M. Protect duct interiors from the elements and foreign materials throughout construction. Follow SMACNA’s “Duct Cleanliness for New Construction.” Deliver ducts with shop-applied impervious protective covering over all open ends. Maintain protective end coverings through shipping, storage, and handling to prevent entrance of dirt, debris, and moisture. Elevate stored ducts above grade. As ductwork is installed, remove protective end covering as each successive segment is connected, but with protective end covering maintained over open ends remaining exposed.

### 3.04 SEAM AND JOINT SEALING SCHEDULE

A. General: Ducts noted as welded in the Duct Material Schedule above shall be made liquid-tight with all joints and seams full-penetration welded continuously along the entire length of the seam or joint. Otherwise, seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA HVAC Duct Construction Standards – Metal and Flexible except where more stringent requirements are specified herein.

B. Seal externally insulated ducts before insulation installation.

C. Seal Class Schedule: Seal Class A and Leakage Class 6 is required for all ducts except as noted below.
   1. Spiral lock-seams need not be sealed.
   2. Transfer air ducts and transfer air boots need not be sealed.

D. Rectangular Duct: Sealant materials and methods shall be at contractor’s option, chosen from among the products specified in Part 2 of this Section; provided that the above seal class and leakage class schedule is met.
3.05 HANGING AND SUPPORTING
A. Install rigid round, rectangular, and flat-oval metal duct with support systems indicated in SMACNA HVAC Duct Construction Standards – Metal and Flexible.
B. Support horizontal ducts within 24-inches (600 mm) of each elbow and within 48-inches (1200 mm) of each branch intersection.
C. Support vertical ducts at maximum intervals of 16 feet (5 m) and at each floor.
D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
E. Install concrete inserts before placing concrete.
F. Install powder-actuated concrete fasteners after concrete is placed and completely cured. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4-inches (100 mm) thick.
G. Repair any building insulation or building fireproofing materials, whether new or existing, that are removed or scraped away in order to attach hangers and supports, so as to maintain an equivalent insulation or fire rating as existed without said hanger or support attachment.

3.06 CONNECTIONS
A. Make connections to equipment with flexible connectors according to Division 23 Section “Duct Accessories.”
B. Comply with SMACNA HVAC Duct Construction Standards – Metal and Flexible for branch, outlet and inlet, and terminal unit connections.

3.07 FIELD QUALITY CONTROL
A. Perform the following field tests and inspections according to SMACNA’s HVAC Air Duct Leakage Test Manual and prepare test reports:
   1. 25% of all outdoor ducts.
   2. 25% of all indoor ducts if design pressure rating is greater than 3-inch w.g.
B. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
C. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days’ advance notice for testing.
D. Maximum Allowable Leakage: Comply with requirements for Leakage Class 6.
E. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.08 CLEANING NEW SYSTEMS
A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.
B. Use service openings, as required, for physical and mechanical entry and for inspection.
   1. Create other openings to comply with duct standards.
   2. Remove and reinstall ceiling sections to gain access during the cleaning process.
C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.
D. Clean the following metal duct systems by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Gas fired furnace internal surfaces and components including mixing box, coil section, condensate drain pans, filters and filter sections, and condensate collectors and drains.
5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.

E. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.
5. Clean coils and coil drain pans according to ACR 2006. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

F. Cleanliness Verification:
1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and reinspect ducts.

END OF SECTION 23 3113
PART 1 - GENERAL

1.01 SUMMARY
A. This Section includes the following:
   1. Backdraft dampers.
   3. Turning vanes.
   4. Duct-mounted access doors.
   5. Flexible connectors.
   6. Duct accessory hardware.

1.02 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “Basic Mechanical Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.03 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.04 QUALITY ASSURANCE
B. Comply with AMCA 500-D testing for damper rating. All manufactured dampers of every type shall bear the AMCA Certified Ratings Program seal for Air Performance, Air Leakage, and Efficiency.

1.05 REFERENCED STANDARDS

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. HVAC Dampers (all types):
      a. Air Balance Inc.; a division of Mestek, Inc.
      b. Greenheck Inc.
      c. Nailor Industries Inc.
      d. Pottorff; a division of PCI Industries, Inc.
      e. Ruskin Company.
   2. Turning Vanes:
      a. Ductmate Industries, Inc.
      b. DuroDyne Inc.
      c. Metalaire, Inc.
      d. Semco Incorporated.
      e. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
   3. Duct-Mounted Access Doors:
      a. American Warming and Ventilating; a division of Mestek, Inc.
b. Cesco Products; a division of Mestek, Inc.
c. Ductmate Industries, Inc.
d. Flexmaster U.S.A., Inc.
e. Greenheck Fan Corporation.
f. McGill AirFlow LLC.
g. Nailor Industries Inc.
h. Pottorff; a division of PCI Industries, Inc.
i. Ventfabrics, Inc.
j. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
k. Ruskin Company.

4. Flexible Connectors:
   a. Ductmate Industries, Inc.
   b. Duro Dyne Inc.
   c. JP Lamborn Co.
   d. Ventfabrics, Inc.
   e. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

2.02 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: Lock-forming quality; complying with ASTM A653/A653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Minimum Thickness: All sheet steel used on this project shall be a minimum of 24-gage thickness, and all aluminum sheets shall be a minimum of 0.04-inch thickness, regardless of whether or not SMACNA standards permit thinner gage material.

D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

E. Tie Rods: Comply with Articles 2.5 through 2.9, including all accompanying Tables and Figures, of the SMACNA HVAC Duct Construction Standards.

2.03 BACKDRAFT DAMPERS
A. Description: Gravity balanced, suitable for horizontal installations. The following requirements apply to conventional backdraft dampers, pressure relief dampers, and barometric relief dampers.

B. Rated Air Velocity: 3000 fpm (15 m/s).

C. Rated System Pressure: 2-inch wg (0.5 kPa).

D. Frame: Match material options below to material of adjacent ductwork. For duct material, refer to Division 23 Section “Metal Ducts.”
   1. 18-gage or 0.052-inch- (1.3-mm-) thick, galvanized sheet steel, with welded corners and mounting flange.

E. Blades: Multiple single-piece blades, maximum 6-inch (150-mm) width, 18-gage or 0.050-inch- (1.2-mm) thick aluminum sheet with sealed edges.

F. Blade Action: Parallel.

G. Blade Seals: Extruded vinyl or neoprene, mechanically locked into blade edge.

H. Blade Axles: Nonferrous metal, with diameter of 0.20-inch (5 mm).

I. Tie Bars and Brackets: Aluminum.

J. Return Spring: Adjustable tension.
K. Bearings: Steel ball or synthetic pivot bushings.

L. Required accessories:
   1. Adjustment device to permit setting for varying differential static pressure.
   2. Counterweights and spring-assist kits, if vertical airflow installation.
   3. 90-degree stops.
   4. Duct mounting flange(s).

M. Sleeve: Minimum 20-gage or 0.040-inch- (1.0-mm) thickness.

2.04 MANUAL VOLUME DAMPERS

A. Manual volume dampers shall be standard leakage rating, with linkage outside airstream, suitable for horizontal or vertical applications. Volume dampers may be factory-manufactured or contractor-fabricated per SMACNA Fig. 7-4/7-5.

B. Material: Match material options throughout this subsection to the material of adjacent ductwork. For duct material, refer to Division 23 Section "Metal Ducts."

C. Frames: Hat-shaped channels with mitered and welded corners, flanges for attaching to walls, and flangeless frames for installing in ducts.
   1. Galvanized-steel, 16-gage or 0.064-inch (1.62-mm) minimum thickness, for use in galvanized steel ducts.

D. Blades: Multiple-blade; single-blade if duct dimension is 12-inch or less in the direction perpendicular to damper axis. Parallel or opposed-blade design (contractor’s choice, unless a specific type is indicated). Stiffen damper blades for stability.
   1. Galvanized-steel, 16-gage or 0.064-inch (1.62 mm) thick, for use in galvanized steel ducts.
   2. Roll-Formed Aluminum, 12-gage or 0.10-inch- (2.5-mm-) thick aluminum sheet, for use in aluminum ducts.
   3. Stainless-steel, 16-gage or 0.064-inch (1.62 mm) thick, for use in stainless steel ducts.
   4. The above requirements may be reduced to 20-gage for round dampers installed in round ducts.

E. Blade Axles: Galvanized steel, aluminum, or stainless steel, as required to match blade material. Dampers shall have axles full length of damper blades, and bearings at both ends of operating shaft.

F. Bearings: Oil-impregnated bronze, molded synthetic, and stainless-steel sleeve-type are acceptable.

G. Tie Bars and Brackets: Galvanized steel or aluminum.

H. Jackshaft:
   1. Size: 1-inch (25-mm) diameter.
   2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
   3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

I. Damper Hardware:
   1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a ¾-inch (19-mm) hexagon locking nut.
   2. Include center hole to suit damper operating-rod size.
   3. Include elevated platform for insulated duct mounting.

2.05 TURNING VANES

A. All turning vanes, where required, shall be single-thickness type, 2-inch (50-mm) radius, 1½-inch (38-mm) spacing, at least 24-gauge thickness, and curved through an arc
matching the change of direction (i.e., a vane curved through 90-degrees for a 90-degree elbow). Construct of material matching that of the adjacent duct (i.e., galvanized steel turning vanes in a galvanized steel duct, stainless steel turning vanes in a stainless steel duct, etc.).

B. Where two or more changes of direction occur with less than four duct widths (measured in the plane of the change of direction) between each elbow, each turning vane shall also include a straight trailing edge extension of 1-inch (25 mm). At contractor’s option, all turning vanes may include this straight trailing edge extension even if not required.

C. Include vane rails or runners for attachment of vane blades to duct.

D. Either contractor-fabricated or factory-manufactured turning vanes meeting these specifications will be acceptable.

2.06 DUCT-MOUNTED ACCESS DOORS

A. Duct-Mounted Access Doors: Factory-manufactured doors, airtight and suitable for duct pressure class.

B. Door: Double wall, rectangular, galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.

C. Insulation: 1-inch (25-mm-) thick, fibrous-glass or polystyrene-foam board.

D. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.

E. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

F. Number of Hinges and Locks: Two hinges, or continuous piano hinge, and two sash locks.

G. Size: 18 by 10-inches (460 by 250 mm) unless noted otherwise.

2.07 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 5¾-inches (146 mm) wide attached to 2 strips of 2¾-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.

D. Fabric: Glass fabric double-coated with neoprene or polychloroprene. Fabric layers shall be shielded with metal on both sides at the seam, attached with a mechanical metal-to-fabric bond.

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°F (Minus 40 to plus 93°C).
4. Insulated Service: Flexible ductwork connections shall be constructed of two layers of fabric as specified above, encapsulating 1-inch nominal thickness of R-4.2 fiberglass insulation. Required if the adjacent ductwork is specified to be insulated or internally lined.
5. Outdoor Service: Glass fabric shall be double-coated with weatherproof, synthetic rubber resistant to UV rays and ozone. Required if installed outdoors.

E. Thrust Limits: As specified in Division 23 Section “Mechanical Vibration Isolation.”

2.08 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

3.01 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible.”

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts.
   1. Locate dampers at least two duct diameters from fittings and as far away as possible from outlets.
   2. Install steel volume dampers in steel ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. Elsewhere as indicated.

H. Install access doors with swing against duct static pressure.

I. Label access doors according to Division 23 Section “Basic Mechanical Materials and Methods” to indicate the purpose of access door.

J. Install flexible connectors to connect ducts to equipment using metal-edged connections or flanges.

K. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

L. Connect air devices to ducts with flexible duct clamped or strapped in place.

M. Connect air devices to ducts directly.

N. Install duct test holes where required for testing and balancing purposes.

3.02 FIELD QUALITY CONTROL

A. Operate dampers to verify full range of movement.

B. Inspect locations of access doors and verify that purpose of access door can be performed.

C. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 3300
SECTION 23 3423
FANS AND VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes the following:
   1. In-line centrifugal fans.

1.2 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “Basic Mechanical Materials and Methods” all apply to the work of this Section as if fully repeated herein.
C. The following Sections contain requirements that relate to this Section:
   1. Division 23 Section “Motors” specifies the motors required for use with fans.
   2. Division 23 Section “Duct Accessories” for duct flexible connectors.
   3. Division 23 Section “HVAC Instrumentation and Controls” for control devices.
D. Stand-alone fans are specified herein. Refer to other Division 23 Sections for fans which are an integral part of packaged equipment.

1.3 PERFORMANCE REQUIREMENTS
A. Project Altitude: Base fan-performance ratings on sea level, unless noted otherwise.
B. Operating Limits: Classify according to AMCA 99-16.
C. Fan Unit Schedule: The following information is specified in an equipment schedule on the Drawings.
   1. Fan performance data including capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
   2. Fan arrangement including wheel configuration, inlet and discharge configurations, and required accessories.

1.4 SUBMITTALS
A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
B. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material thickness and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.
   6. Fan speed controllers.
C. 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.
D. Wiring Diagrams: Detail wiring for power and control systems, and differentiating clearly between manufacturer-installed and field-installed wiring.
E. Field quality-control test reports.
F. Operation and Maintenance Data: For fans and ventilators to include in emergency, operation, and maintenance manuals.
1.5 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. AMCA Compliance: All fans and ventilators shall bear the AMCA Certified Ratings Program seal for Air and Sound Performance. In addition, compliance with either one or both of the following two subparagraphs is required.
   1. All fans and ventilators shall bear the AMCA Certified Ratings Program seal for Fan Efficiency Grade (FEG).
   2. All fans and ventilators shall bear the AMCA Certified Ratings Program seal for Fan Energy Index (FEI).
C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
D. UL Standard: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
B. Disassemble and reassemble units, if required for moving to final location, according to manufacturer's written instructions.
C. Lift and support units with manufacturer's designated lifting or supporting points.

PART 2 - PRODUCTS
2.1 GENERAL REQUIREMENTS APPLICABLE TO ALL FANS AND VENTILATORS
A. Manufacturers: Subject to compliance with requirements, provide fans and ventilators by one of the following:
   1. Greenheck Inc.
   2. Loren Cook Company.
   3. PennBarry, division of Air System Components.
   4. Twin City Fan Company.
B. Single Source: All fans of any given type shall all be provided by the same manufacturer.
C. Motors: Refer to Division 23 Section “Motors” for general requirements for factory-installed motors, whose requirements apply to the work of this Section as if fully repeated herein.
   1. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.
   2. Enclosure Type: Open drip-proof, where satisfactorily housed; guarded drip-proof, where subject to contact by employees, maintenance staff, or building occupants.
   3. Motor Sizes: Minimum size as indicated, but larger if necessary so driven load will not require motor to operate in service factor range at design point, and larger if necessary so driven load will not require motor to operate beyond the service factor at any point on the fan curve.
D. Disconnect Switch: Provide a factory-installed and pre-wired non-fused disconnect switch for all fans and ventilators, unless specifically noted otherwise.
E. Factory Finishes: Provide as follows.
   1. Sheet Metal Parts: Prime coat before final assembly.
   2. Exterior Surfaces: Baked-enamel finish coat after assembly. Finish shall pass a 1,000-hour salt spray test conducted per ASTM B117 method.
   3. Aluminum Parts: No finish required.
2.2 IN-LINE CENTRIFUGAL FANS

A. Description: In-line centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories. Provide direct-drive or belt-drive as indicated via Schedule on Drawings.

B. Housing: 18-gauge galvanized steel bolted construction, corrosion-resistant fasteners, access doors, straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting. Bolted access doors shall be provided on three sides, sealed with closed cell neoprene gaskets.

C. Fan Wheels: Aluminum, backward-inclined blades welded to cast aluminum hub.

D. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

E. Shaft Bearings: Pre-lubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 11, L10 of 100,000 hours.

F. Required Accessories:

1. Variable Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Companion Flanges: For inlet and outlet duct connections.
3. Vibration Isolators: Restrained spring isolators having a static deflection of 1 inch (25 mm).
4. Any other accessories as indicated via Schedule on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the fans and ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fans and ventilators level and plumb, and in accordance with manufacturer’s written instructions.

B. Install fans and ventilators using vibration isolators. Vibration-control devices are specified in Part 2 of this Section.

C. Install units with clearances for service and maintenance.

D. Label units according to requirements specified in Division 23 Section “Basic Mechanical Materials and Methods.”

3.3 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section “Duct Accessories.”

B. Coordinate ducts, pipes, conduit, and other work adjacent to fans and ventilators to allow service and maintenance clearance in accordance with manufacturer’s installation instructions.

C. Connect wiring and ground equipment according to Division 26 Sections.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.
B. Lubricate bearings.

3.5 CLEANING
A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.
B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

3.6 FIELD QUALITY CONTROL
A. Manufacturer's Field Service: Provide the services of a factory-authorized field service representative to inspect the installation of fans, including duct and electrical connections, and to report the results in writing. The field service representative shall perform, or shall witness the contractor's performance of, the following field tests and inspections and prepare test reports.
1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Verify lubrication for bearings and other moving parts.
5. Verify that manual dampers in connected ductwork systems are in fully open position.
6. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
7. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
8. Shut unit down and reconnect automatic temperature-control operators.
9. Remove and replace malfunctioning units and retest as specified above.
10. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.7 DEMONSTRATION
A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fans and ventilators. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
B. Review data in maintenance manuals. Refer to Division 01.
C. Schedule training with Owner, through Architect, with at least seven days' advance notice.
D. Demonstrate operation of fans and ventilators. Conduct walking tour of the Project. Briefly identify location and describe function, operation, and maintenance of each fan and ventilator.

END OF SECTION 23 3423
PART 1 - GENERAL

1.01 SUMMARY
A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.02 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “Basic Mechanical Materials and Methods” all apply to the work of this Section as if fully repeated herein.
C. The following Sections contain requirements that relate to this Section:
   1. Division 23 Section “Testing, Adjusting, and Balancing” for balancing diffusers, registers and grilles.

1.03 DEFINITIONS
A. Diffuser: Square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
C. Register: A combination grille and damper assembly over an air opening.

1.04 SUBMITTALS
A. Product Data: For each 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.

1.05 QUALITY ASSURANCE
B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A-2015 Standard for the Installation of Air-Conditioning and Ventilating Systems. Where located less than 84 inches above finish floor, diffusers, registers and grilles shall be designed to prohibit passage of a ½-inch sphere.
C. Single-Source: Unless noted otherwise, a single manufacturer shall furnish all diffusers, registers, and grilles.

PART 2 - PRODUCTS

2.01 COMMON REQUIREMENTS, ALL UNITS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Carnes Co.
   3. Hart & Cooley, Inc.
   4. Metalaire, Inc.; Metal Industries Inc.
5. Nailor Industries, Inc.

B. Diffusers, registers, and grilles are scheduled on Drawings. All model numbers, finish designations, border types, and accessory designations are based on one manufacturer identified therein. Products by other manufacturers listed above may be furnished, but must be equal in all respects to the device identified, including but not limited to NC, pressure, and cfm ratings.

C. Diffusers, Registers, and Grilles Finish: Acrylic baked enamel paint, pencil hardness HB to H, color as scheduled. The finish shall pass a 250-hour ASTM 870 Water Immersion Test, a 100-hour ASTM D117 Corrosive Environments Salt Spray Test, and a 50 inch-pound ASTM D2794 Reverse Impact Cracking Test.

D. Integral Balancing Damper: Where dampers are scheduled as an integral part of diffusers and grilles (registers), provide multi-blade gang-operated opposed-blade type, radial-style if used with round ducts; 24 gage galvanized steel, except that aluminum dampers shall be used with aluminum diffusers and registers. Integral dampers shall be operable from the room side of the diffuser or register without special tools.

E. Diffusers, Registers, and Grilles Mounting: Provide border frame mounting type as scheduled. If not scheduled, provide border frame mounting type compatible with ceiling or wall type indicated on Architectural Drawings. Distinguish between flush flat-tee lay-in ceilings, drop-face lay-in ceilings, and the narrow-tee or screw-slot lay-in ceilings by providing a border type specifically designed for each as applicable; a generic standard lay-in border frame will not be acceptable for multiple lay-in ceiling types.

2.02 PRODUCT SPECIFICATIONS

A. Standard-Performance Grille: Adjustable double-deflection supply grilles, single fixed deflection return grilles, of sizes and performance as scheduled. Blades shall be 24-gage aluminum; supply grille blades shall be individually adjustable and held in place without rattling or slip by tension wire or metal friction pivots. Frame shall be roll-formed 24-gage aluminum or with 1-inch minimum flange and full penetration welds at the corners. Exposed screw holes shall be countersunk for flush finish surface.

B. Other grilles, registers and diffusers not specified above may be specified on the Drawings or by virtue of make and model number on the Schedule.

2.03 FIELD-PROVIDED ACCESSORIES

A. Other accessories may be required by virtue of notations on the Schedule or as detailed on the Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Install diffusers, registers, and grilles level and plumb.

C. 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 practicable. 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.
D. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

E. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

F. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 23 3713
SECTION 23 3750
GARAGE EXHAUST REMOVAL SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes all labor, materials, and equipment necessary to put in working operation a complete turnkey system to remove both diesel and automotive exhaust gases and particulate of operating vehicles within the confines of specified fire station(s). All necessary controls, motors, fittings, ductwork, blower(s), labor and all other equipment and materials specified shall be part of the work.

B. This Section includes the following:
   1. Manufacturer.
   2. Sliding Track.
   4. Double Track Joiner Plate.
   5. Track Splicing Assembly.
   6. Riser Clamp Assembly.
   7. Trolley / Balancer Assembly.
   8. Upper Flexible Hose.
   9. Lower Hose Assembly.
  10. Safety Disconnect Coupling.
  11. Collection Nozzle Assembly.
  13. Electrical Controllers.
  15. Air Moving Devices.

C. All items of equipment and materials described in these specifications are to be furnished installed and placed into proper operating condition in accordance with good practice and manufacturer’s written or published instructions.
   1. The exhaust removal system shall provide virtually 100 percent complete evacuation of all diesel fumes at the source from start up to exit of the apparatus from the fire station. The diesel exhaust removal system shall be capable of delivering complete coverage for bays up to 60 feet (18.3M) in length. The system must be able to accommodate drive through and back-in bays to meet all the needs of the fire department.
   2. System must be designed and installed to NIOSH recommendation, specifying that occupational exposures to carcinogens be limited to the lowest feasible concentration. Exposure in the human breathing zone should be limited to lowest feasible level, without any time delay required for the system to effectively capture the diesel fumes.
   3. System must also be capable to provide virtually complete capture and evacuation of carbon monoxide emitted as part of the vehicle exhaust.
   4. System shall be NFPA Apparatus Code 1901, Section 12.2.6.6 compliant. This is considered a life safety issue – No Exceptions.
   5. Systems that solely use filters, in which diesel particulate may accumulate, and that would potentially have to be treated as hazardous materials, will not be accepted.
   6. System must meet the guidelines for the International Mechanical code for Source Capture Systems. Such system is defined as a mechanical exhaust system designed and constructed to capture air contaminants at their source and to exhaust such contaminants to the outdoor atmosphere.
7. The system shall not affect personnel boarding the apparatus. Hose loops shall not hang any lower than six feet from the bay floor. The hose assembly shall not come into contact with the vehicle other than one connection point to the vehicle’s tailpipe. The hose assembly shall not touch or drag on the bay floor.

8. The exhaust system shall not block doorways, exits, and aisles in the apparatus bay, which could endanger the welfare of fire personnel or visitors.

9. The exhaust system shall not need to be disconnected from the vehicle while shore lines are connected, during battery charging, or washing of the vehicle, as with other types of systems.

10. To protect the apparatus electrical system from possible damage, the system bid shall not incorporate any type of electromagnetic device that requires the apparatus to be utilized as an electrical ground for systems operation.

11. Due to the harmful effects of diesel exhaust, the system must be designed and capable of capturing virtually 100% of the exhaust gas and virtually 100% of the particulate even in the event of a complete power failure. The system shall not detach itself from the apparatus for any reason during a power failure other than normal exiting of the apparatus bay. System shall discharge exhaust outside the station even in the event of a power failure.

12. The system shall capture the exhaust gases and particulate directly from the tailpipe of the apparatus by a direct connected “visible” high temperature rated hose. Particulates emitted from the apparatus are known to be heavier than air and therefore must be captured by a directly connected hose with a tight seal, as loose nozzles or air filters cannot capture these heavy particulates. The particulates have been documented to be the main respirable carcinogen in diesel exhaust, and therefore are the primary concern of the fire department to capture virtually 100% of these particulates.

1.02 RELATED DOCUMENTS

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

B. Section 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “Basic Mechanical Materials and Methods” all apply to the work of this Section as if fully repeated herein.

C. The following Sections contain requirements that relate to this Section:
   1. Division 23 Section “Motors” specifies the motors required for use with fans.
   2. Division 23 Section “Duct Accessories” for duct flexible connectors.

1.03 SUBMITTALS

A. Product Data: Indicate manufacturer’s model number, technical data including description of components and static pressure/air flow chart, and installation instructions.
   1. Details of wiring for power differentiating between manufacturer-installed and field-installed wiring.

B. Closeout Submittals: Operation and Maintenance data manual including spare parts list.

1.04 QUALITY ASSURANCE

A. Engage a factory certified installer to perform work of this Section who has completed installations similar in design and extent to that indicated for this Project, and who has a record of successful in-service performance. No Exceptions.

B. The manufacturer must be a ISO 9001:2000 certified www.iso.org manufacturer with certification issued to a United States facility, this shows a commitment to delivering the highest quality service and products to the end user. Manufacturer shall be UL and CUL Certified www.ul.com/database/ and certified by the Air Movement and Control
Association (AMCA) [www.amca.org/search.htm](http://www.amca.org/search.htm) to ensure quality, consistency and reliability of products. All certification documents shall be provided and attached to the bid proposal. No exceptions.

C. Engage a firm experienced in manufacturing vehicle exhaust systems similar to that indicated for this Project and with a record of successful in-service performance.

D. Conduct conference at Project site. Review methods and procedures related to vehicle exhaust system installation.
   1. Review access requirements for equipment delivery.
   2. Review equipment storage and security requirements.
   3. Inspect condition of preparatory work performed by other trades.
   4. Review structural loading limitations.
   5. Review that all components specified in this Section and related components specified in other Sections are accounted for.

1.05 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading: Deliver components with protective packaging. Store in original protective crating and covering and in a dry location.

1.06 COORDINATE

A. Coordinate layout and installation with other work, including light fixtures, fixed equipment and work stations, HVAC equipment, overhead doors and tracks, and fire-suppression system components.

B. Coordinate location and requirements of service-utility connections.

1.07 BIDDER QUALIFICATIONS

A. Bids will only be accepted from companies that have an established reputation in the business of system design, turnkey installation and long-term service of Automatic Emergency Response Vehicle Exhaust Removal Systems for a minimum of no less than five (10) years. Bidder shall be a registered corporation, partnership or sole proprietorship within the State where the installation is to take place. Bidder must have a current and valid state contractor's license, if required by the state for the work that is being bid. Bidder shall show proof that the system specified in this Bid Document has been field tested and proven by supplying a list of references with no less than 30 fire stations with systems installed by bidder (with comparable emergency and non-emergency run rates) within a 200 mile radius of municipality seeking bid. References shall be submitted with the Bid Document and shall include phone numbers and contact names.

B. Any company offering a bid including a manufacturer other than the one listed above is required to have a written letter from the owner stating the substitute manufacturer’s product is considered an equal. This letter must be signed by the owner and dated a minimum of 30 days prior to the bid date.

C. Any company offering a bid including a manufacturer other than the one specified is required to have submitted that manufacturer’s product submittals to the architect for approval 10 days prior to the bid date.

1.08 MANUFACTURER QUALIFICATIONS

A. Bids shall only be accepted by bidders supplying equipment from manufacturers that have an established reputation in the business of manufacturing Automatic Emergency Response Vehicle Exhaust Removal Systems for a minimum of no less than fifteen (15) years. The manufacturer must be a ISO 9001:2000 Certified in the United States [www.iso.org](http://www.iso.org), UL and CUL Certified [www.ul.com/database/](http://www.ul.com/database/) and certified by the Air Movement and Control Association (AMCA) [www.amca.org/search.htm](http://www.amca.org/search.htm) to ensure quality, consistency and reliability of products. Certification documents shall be provided
and attached to the bid proposal. **No exceptions.** Where the requirement calls for a packaged exhaust system to be provided, all items shall be the product of the manufacturer. The product offering must be a product that has been offered by that manufacturer for a minimum period of fifteen (15) years. No prototypes or private label products by other manufacturers will be allowed. System bid shall have a life of service of no less than 10 years to establish proof of quality, longevity and service. **No exceptions.**

**1.09 WARRANTY**

A. Provide a written warrantee for a period of three (3) years from date of shipment for all components. One year on-site service to be provided by factory certified installer.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURER**

A. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equal:

1. PlymoVent Corporation/Plymovent Industrial Ventilation Systems, 5 Corporate Drive, Cranbury, New Jersey 08512, USA, Telephone: (609) 395-3500, Toll Free: (800) 644-0911; FAX: (609) 655-0569; WEB: info@plymoventusa.com

**2.02 SLIDING TRACK**

A. A one-piece continuous extruded aluminum track in a minimum length of 19 feet (5791.2 mm). Profile shall be of a Boxloc type profile, track height 3-1/8 inches (73.4 mm), track width 1-½ inches (38.1 mm), track thickness 1/8 inch (3.175 mm); aircraft aluminum alloy Type AA-6063 (ASTM B209/B209M). Track: Extruded design that shall incorporate three separate and functioning channels. Channels: Includes the mounting channel, the trolley channel and the Boxloc channel. Mounting Compartment: Designed to accept the slider bars (which shall be provided with factory supplied vertical support legs and riser clamp duct connection) and to allow positioning along the full length of the slotted track-mounting channel. Mounting Channel: Also accommodate the compressed airlines for the purposes of safe storage and appearance. Trolley Channel: Allow the trolley/balancer/ hose assembly to glide to the door threshold in a safe and effective manner. Boxloc Channel: Allow the whole track to remain rigid as it hangs from factory supplied leg supports and also shall provide an area to attach bolts for splicing additional tracks together for systems over 19 feet (5791.2 mm) long. The overall extruded track lengths shall be 19 foot standard and shall weigh no more than 35 pounds (15.88 KG). The track system shall be equipped with end stops that limit travel of flex hose as the vehicle exits the building. The end stop shall be fabricated of zinc plated steel in a U shape form with a rubber end stop on the impact end. It shall be attached by using a ¼ inch (6.35 mm) molded locking bolt. The end stop shall be secured to the track with no less than (2) ¼ inch (6.35 mm) bolts and locking nuts located on the underside of the track. For security, a ¼ inch 6.35 mm) bolt shall be drilled through the ends of each track system to ensure that the trolley/balancer assembly(s) roll no further than the end of the track system.

**2.03 SUPPORT LEGS**

A. Support Leg and Mounting Feet: Manufactured and provided by the supplier of primary exhaust removal system (Equipment Manufacturer). Leg Material: Aircraft aluminum alloy Type AA-6063 (ASTM B209/B209M). Supports shall come standard in 19 feet (5791.2 mm) lengths. A minimum of one support with appropriate bracing shall be provided for every 10 linear feet (3048 mm) of track profile. The support legs shall consist of a square tubular profile with dimensions no less than 2 inch (50.8 mm) OD X 0.1 inch (2.54 mm) with 0.4 inch (10mm) fastening hardware provided. Vertical
Adjustable Mounting Foot: Capable of attaching the leg assembly to a ceiling with a 30 degree pitch, complete with a slider bar and 3/8 inch (9.5 mm) hardware necessary for mounting the horizontal track to the mounting channel system. Horizontal Adjustable Mounting Foot: Capable of attaching the leg assembly to a wall, complete with a slider bar and 3/8 inch (9.5 mm) hardware necessary for mounting the horizontal track to the mounting channel system. Support Leg: Equipped with round tubular zinc-plated steel knee brace with pressed ends in standard lengths of 20 inches (508 mm), 30 inches (762 mm) and 72 inches (1828.8 mm). Angle Completely adjustable to the leg support and mounted perpendicular and parallel to direction of the track. Typical Support Angle: 45 degrees from the centerline of the factory provided support leg. The standard leg shall be capable of meeting a Seismic 4 requirement. "Uni-strut", all-thread rod, and/or chains may not be used in place of a leg assembly or to support the system.

2.04 DOUBLE TRACK JOINER PLATE
A. Joiner Plate: constructed from a minimum of ¼ inch (6.35 mm) thick zinc-plated material, designed to connect two parallel tracks to make a double track system to accommodate an apparatus bay over 40 feet (12192 mm) in length. Joiner Plate: 10 inch (254 mm) by 8 inch (203.2 mm) flat zinc-plated steel and designed to attach the two tracks to a single factory supplied support leg. The steel plate shall have (6) 3/8 inch (9.5 mm) holes drilled 6-7/8 inches (174.6 mm) apart to accommodate the slider bar provided with factory support legs. Joiner Plate: Have two slider bars attached to the plate, located on the outside edges of the plate. These slider bars shall fit into the Boxloc track mounting channel for a simple and secure attachment of the plate to the Boxloc track. The center portion of the joiner plate shall provide attachment for the factory supplied support leg.

2.05 TRACK SPlicing ASSEMBLY
A. Track Splice: Manufactured of galvanized steel (ASTM A653/A653M) in two parts and utilized as a clamping device. This clamp shall accurately secure both tracks together in a fashion, which shall eliminate any possibility of obstructing the trolley assembly as it passes through this connection point of track system. Connecting length of splice shall be a minimum of 15-3/4 inches (400 mm) long and fabricated of 14 gauge material. Four (4) 1/4 inch (6.35 mm) bolts with lock nuts shall pass directly through internal partition of the Boxloc track. The splicing sleeve shall fit externally around the outside dimension of extruded aluminum track profile.

2.06 RISER CLAMP ASSEMBLY
A. Riser Clamp: Fabricated as a one piece welded assembly, manufactured to create the transfer of the hard spiral pipe joined at the top and flexible duct connection at the bottom. A slider bar and associated hardware shall be provided with riser clamp assembly. Sizes of the riser clamp will range from 4 inches (101.6 mm) to 5 inches (127 mm) in diameter to match the output velocity of the vehicles that will park in that station.

2.07 TROLLEY/BALANCER ASSEMBLY
A. Trolley Assembly: Manufactured as a two piece galvanized steel assembly including bumper stops at each end. Fixed to the side of the trolley are solid steel pins, which shall be for load carrying bearings that are sealed and permanently lubricated. The load carrying bearings shall travel internally in track trolley channel. Two additional permanently lubricated trolley wheels shall be provided on bottom side of the track to reduce wobble of trolley as it conveys the hose assembly to the door threshold. Release Plate: Attached to the chassis of the trolley to smoothly energize the uncoupling release valve when the trolley-balancer assembly approaches the door threshold. System Balancer Assembly: Self-adjusting weight spring tension balancer with a lifting capacity of no less than 31 pounds (14 KG). The balancer shall have a minimum diameter stainless steel cable of .080 inch (2 mm), with a safety link connection.
2.08 UPPER FLEXIBLE HOSE
A. Upper Hose: Flexible exhaust hose manufactured for the sole purpose of venting high temperature exhaust gases. Flexible Hose: Designed strictly for the harsh environment of rapid response and auto-release of a vehicle exhaust tailpipe. Hose: Range from 4 inch (101.6 mm) to 5 inch (127 mm) diameters with varying lengths depending on the system length required ranging from 20 feet (6096 mm) to 43 feet (13106 mm) without joining or splicing connections. Hose Material: High temperature synthetic rubber impregnated into a high temperature laminated fabric with a minimum overlapping thickness of 2-7/16 inches (61.9 mm). This construction of hose must be capable of operating at continuous temperatures of 400 degrees F (204 degrees C) and intermittent temperatures of 500 degrees F (260 degrees C) such as are experienced when pump checks are performed inside the station. Wire Helix: Bound and protected in laminations of hose winding. This shall be accomplished in a fashion, which eliminates any possibility of personnel coming in contact with an exposed hot metal helix. The hose shall further protect the internal wire helix from heat buildup and in turn add increased visibility to personnel. Wear Strip: 9/16 inch (14.28 mm) wide and be provided as a safety yellow color. The bend radius of the high temperature hose shall be no less than 1.5 times the diameter of hose to ensure that hot gases are not restricted as they pass through the system. Hoses utilizing an exposed metal helix will not be acceptable due to potential burn hazard and/or shock hazard from being utilized as a grounded, grounding or current carrying conductor for electromagnet connections. No exceptions will be allowed.

2.09 LOWER HOSE ASSEMBLY
A. Lower Hose: Rigid 4 inch (101.6 mm) to 5 inch (127 mm) diameter by 2 foot (609.6 mm) long section of yellow and black hose identical in appearance to the upper hose assembly. Lower Hose: Support the connection nozzle and Stainless reducing elbow in a rigid fashion to allow for the operator to place hose collection nozzle onto the tailpipe without bending over. The lower hose is the only section of hose which shall disconnect from the upper hose assembly and act as a safety disconnect in the unlikely event the nozzle gets entangled. Hoses utilizing an exposed metal helix will not be acceptable due to potential burn hazard.

2.10 SAFETY DISCONNECT COUPLING HANDLE
A. Safety Disconnect Coupling: Coupling: Consists of two high temperature metal collars connected by a reusable 3 spring/latch coupling bands. For a pneumatic system, the handle shall incorporate a manual fill / deflation valve for the operation of inflating the Grabber Nozzle. The release tension of this device shall be preset at about 99 lbs. of force. This design accommodates varying exit speeds of vehicles. Re-coupling shall easily be accomplished by re-inserting the lower hose section with metal flange into the lower part of the Safety Disconnect Handle. Re-connection shall only require about 33 lbs. of force. This item is considered a Life Safety Feature – No Exceptions.

2.11 COLLECTION NOZZLE ASSEMBLY
A. Collection Nozzle Assembly: Provides a substantially air tight seal around exhaust tail pipe when connected thus allowing for virtually 100% source capture. The seal shall limit escape of life threatening exhaust gases, which may be present during the following conditions:
   1. In the event vehicle's engine is accelerated above normal idle resulting in an exhaust velocity greater than 5000 feet per minute (25.4 meters per second).
   2. In the event that the output velocity or CFM of the exhaust exceeds the manufacturers normal capture velocity or CFM of exhaust system.

B. Magnetic Nozzle: Engineered and specially designed Patent Pending exhaust system nozzle (female connection) that is specifically designed to fit tightly over the circumference of an engineered conical mating ring (male connection) that attaches to
the tail pipe and attaches tightly around the ring to capture virtually 100% of the carcinogenic diesel exhaust.

C. The Stainless-reducing elbow that connects to the connection nozzle shall be fabricated using continuous welded construction. Angle of Transition: No less than or greater than 67 degrees from the centerline of the reducer. Stainless Reducer: Incorporate a primary expanded metal debris screen, which is permanently affixed by welded seams to the inside, opening of exhaust fitting.

2.12 HOSE SADDLE
A. Hose Suspension Saddle: Fabricated of a rubber molded cushion specifically manufactured for the sole purpose of suspending high temperature exhaust ventilation hose in a rapid response and auto-release application. The design of the saddle shall smoothly transition the direction of the hose during its travel along the track. Securing clamps shall be provided including a link fastener, for the purpose of mounting it to the balancer safety link.

2.13 ELECTRICAL CONTROLLERS
A. Controller: Built and supplied by a UL recognized and listed exhaust system manufacturer. Controller shall carry the UL - CUL listing label as an “Enclosed Industrial Control Panel.” Individual components listed by UL - CUL shall not satisfy the above requirement. Manufacturer shall undergo monthly inspections by UL to verify all requirements and standards are met as outlined by UL. The controller shall be delivered as an Operating System Three series controller or an approved equal to the specifications to follow.

B. Electrical Controllers: Bear a visible UL listing label as proof of subscribership and shall be validated by UL www.ul.com/database/ as an “Enclosed Industrial Control Panel”. Certification documents shall accompany bid documents.

1. Manufacturer Name: 
2. UL File No.: 
3. Electrical controller and manufacturer shall be recognized and listed by UL. Controller shall be manufactured in accordance with Underwriters Laboratories standard UL-508 for “Enclosed Industrial Control Panels”. The electrical controller shall include a Class 1 limited energy control circuit. Enclosures shall be NEMA 12 rated and UL listed as Type 12. The electrical control components shall be provided and mounted in an electrical enclosure to restrict access to internal components of the controller by authorized personnel only.

C. Controller Performance: Wireless Plug-In transmitters shall activate the Designed control function. The operating logic shall be designed to complete this cycle. At any point in time when a collection device is connected to a motor vehicle's exhaust tailpipe, as the operator starts the vehicle, the wireless transmitter and receiver shall automatically energize the electrical contactor which will supply power to the AMCA certified spark resistant fan motor. Through the use of an adjustable timer the controller shall keep the contactors energized for up to six minutes in accordance with the stations response requirement. To ensure continuous system operation the wireless transmitter will continue to operate the fan, as long as the apparatus is running. This cycle shall not allow the electrical contactor, which energizes the exhaust fan, to short cycle or stop the fan while the system is connected to an operating vehicle.

D. Motor Control Contactor: Allen Bradley Industrial Electrical Contactor 100C series. The contactor shall be UL - CUL listed as an approved component.

E. Motor Control Overload Relay: Allen Bradley 193 E1 Plus series. Overload relay shall have an adjustable trip range to meet the proper full load amperage of the blower motor.

F. Soft Touch Controls: Incorporated on the face or the access door of the controller by the use of an adhesive backed Lexan membrane type label to prevent water infiltration,
which would void the NEMA 12R rating. Label: Provided and secured permanently to the exterior of the electrical controller. Label: Include the name of the manufacturer, address, telephone number, user instructions and any warnings or cautions required by Underwriters Laboratories.

1. Auto Start: This mode of operation shall be strictly for normal day to day use, as it would apply to receiving an emergency call and leaving the station. Any one or combination of the three devices listed below in Paragraph H shall activate the system. The system shall maintain itself in the Auto Start mode and always return there after the Stop sequence has been initiated. The controller shall not have a permanent off position due to the potential health hazards of diesel exhaust components.

2. Stop: This mode of operation shall be a system override to shut down the system manually. Upon activating this mode of operation the exhaust system blower shall shut down. After a period not to exceed three seconds the controller shall automatically return to the Auto Start ready mode. This shall be a safety feature to prevent a potential health hazard from carcinogenic diesel exhaust leakage from systems having an undesirable open nozzle.

3. Manual Run: This mode of operation shall be a system override to run the exhaust system blower continuously for the purpose of running the vehicles indoors for equipment checks during inclement weather. Upon activating this mode of operation the exhaust system blower shall start and run continuously until the Stop mode is activated at which point the system will automatically return to the Auto Start ready mode within a maximum three second time period.

G. System Indicator LED’s: Show system status at all times.

1. Auto Start Indicator: Indicate the system is in the fully automatic mode of operation and that power is on to the controller.

2. Fan On Indicator: Indicate that power is being applied to the system blower and the controller is operating normally.

3. Filter Status Indicator: Indicates, if flashing, excessive pressure loss across the filter bank media. Consequently, the filter must be serviced to maintain optimum efficiency of the system.

4. Stop Indicator: Indicate the fan has been manually de-energized and will return to the Auto Start ready sequence in less than three seconds to prevent the system blower from being left in the Off mode.

5. Manual Run Indicator: Indicate the fan is operating in a continuous run mode until interrupted by the stop mode activation.

H. Controller Transformer: UL listed industrial control circuit transformer sized to properly supply all components so that only one transformer shall be required. Transformer shall be provided with multi-tap primary for 115, 208, 240, 277, 400, 480, and 600VAC, and 24, 120, 230VAC secondary operating on 50 or 60 hertz with a capacity of 90 volt amperes.

I. Control Circuit Protection: By the use of primary and secondary fuses to meet UL requirements. The primary shall be protected by a pair of FLQ style fuses rated at 1.6 amps for voltages under 400V and a pair of .75 amp fuses for voltages over 400V. A single glass fuse rated at 3.15 amps at 250V shall protect the secondary side of the control circuit.

J. Electronic Control Circuit Card: Solid state printed circuit board. The soft controls shall be an integral part of the control circuit card. The control circuit card shall utilize a potentiometer to adjust the length of the timing cycle from 7 to 360 seconds. It shall incorporate several different modes of operation and optional features.

K. Activation Devices:
1. **Wireless Transmitter and Receiver System:** Shall be an optional feature operating on a 2400 Mhz spread spectrum frequency and FCC part 15 compliant. The receiver shall utilize 4 independent programmable channels of control and capable of supporting up to 50 transmitters. The receiver shall operate on 24 VAC and be enclosed inside the OS3 control box. The transmitter shall be programmable and shall be powered by the vehicles’ 12 volt batteries. The transmitter shall have an open field range of 300 feet and shall be initiated by a NO contact closure such as from a pressure switch mounted on the exhaust system or a relay mounted on the vehicle.

L. **Clean Filter Indicator Alarm:** Used in conjunction with the optional Unifilter for filtering diesel exhaust particulate before release to the atmosphere. The clean filter indicator shall monitor the pressure loss across the filter bank media. Once the useful life of the filter has been depleted the pressure differential switch will signal a high-pressure loss and flash the “Fan On” indicator while the exhaust blower is running.

M. **Optional System Monitor:** Shall be an optional feature to monitor the system and advise when a preset number of emergency runs or run time on the system have accrued.

N. **Optional No Airflow Alarm:** Shall be an optional feature to monitor the system and advise when the exhaust fan is not functioning properly.

O. **Optional Carbon Monoxide Alarm:** Shall be an optional feature to monitor the carbon monoxide levels inside the apparatus bay area.

P. **Electrical Wiring:** Run in wire channel to allow for easier identification of the wiring circuits and for a neat appearance. All wiring circuitry shall meet National Electric Code and UL standards for proper size, bending radiuses (NEC code ref. 300-34) and terminations.

Q. **Electrical Terminal Block:** 600 V, UL rated and recognized. It shall provide individual connection points for remote controls, clean filter indicator and power connections. The primary and secondary control wiring fuses shall be incorporated into the terminal block as one unit.

R. **Product Manual:** Shall be provided with each electrical control box supplied. The product manual shall include a description of components with part numbers inclusive to the controller. It shall include a wiring schematic showing all internal circuitry as well as all field installed wiring connections to the controller.

S. **Electrical Interference:** To protect the apparatus and communications, designs that allow any possibility of electrical back-feed or induced current which may interfere with a central services communication or onboard vehicle computer logic or navigational equipment will not be accepted.

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2.14 **ELECTRICAL SYSTEM**

A. **Station Electric Supply Panel:** The power circuit for the “Emergency Response Vehicle Exhaust Removal System” shall originate in a circuit breaker panel board of the appropriate size to handle the load. Fan circuit shall be supplied by a UL listed, HACR rated circuit breaker (HACR rating is specifically for motor type loads) of the same type as indicated by the manufacturer of the circuit breaker panel or a dual element time delay fuse for fuse style panels. The circuit shall be clearly marked on an engraved ledger plate or in ink on the panel schedule as “Emergency Response Vehicle Exhaust Removal System”.

B. **OS-3 Automatic Controller:** Built and supplied by a UL recognized and listed exhaust system manufacturer. Controller shall carry the UL - CUL listing label as an “Enclosed Industrial Control Panel”. Individual components listed by UL shall not satisfy the above requirement. Manufacturer must undergo monthly inspections by UL to verify all requirements and standards are met as outlined by UL. The controller shall be delivered as an Operating System Three series controller or an approved equal to the
specifications in 2.17 Electrical Controllers. The controller shall be mounted 6 feet (1829 mm) to the top of the cabinet AFF (above finished floor). A safety disconnecting means must be within sight of the controller for servicing and for safety reasons. If the supply panel is not within sight, a separate disconnecting means is required beside the controller (per NEC Code 2008). Safety disconnect shall be capable of being locked in the off and on position to follow lockout, tag out procedures. See attached Table 1-1 for proper Square D part number of safety disconnect switch.

C. Power Wiring Conduit: Minimum of EMT utilizing fittings for damp locations such as apparatus wash down areas (per NEC Code 2008). Conduit shall be supported with a conduit strap every 10 feet and within 3 feet of each box or termination, (per NEC 2008).

D. Power Wiring from Supply Panel to OS-3: THHN stranded copper wire consisting of a flame retardant, heat-resistant thermoplastic insulation with a nylon jacket for abrasion, gas, and oil resistance and rated up to 600 volts.

E. Low Voltage Control Wiring: Minimum of a 16/2 multi-conductor cable to meet UL standards for the controller’s low voltage field wiring.

F. Low Voltage Control: Encased in a minimum of ½ inch (12.7 mm) EMT from the OS-3 Controller to the attic or building steel where it shall terminate with a EMT connector with a threaded plastic bushing. Conduit: Supported with a conduit strap every 10 feet and within 3 feet of each box or termination (per NEC Code 2008). The 16/2 multi-conductor cable shall be supported by the building structure and ran in a manner that the cable will not be damaged by normal building use (per NEC Code 2008), securely fastening it with nylon tie wraps every 24 inches (609.6 mm) to 36 inches (914.4 mm). Draping of the cable perpendicular to building steel or support members will be unacceptable.

G. Power Wiring from OS-3 to Fan Motor: Minimum of EMT utilizing compression type fittings for damp locations such as apparatus wash down areas (per NEC Code 2008). Conduit shall be supported with a conduit strap every 10 feet (3048 mm) and within 3 feet (914.4 mm) of each box or termination (per NEC Code 2008). Conduit shall extend through the outside wall through a hole of the proper size and terminate directly into the back of the safety disconnect with the appropriate connector and sealed with a silicon sealer or cement mortar. (Using fan model number select appropriate wire and conduit size from Table 1-1).

H. Fan Safety Disconnect: Square D, non-fusible, NEMA 3R rated for wet locations, mounted adjacent to the AMCA Certified blower. Safety disconnect shall be capable of being locked in the off and on position to follow lockout, tag out procedures. (Using fan model number select appropriate safety disconnect from attached Table 1-1).

I. Liquid Tight Flexible Metal Conduit: UL listed liquid tight flexible metallic conduit (Sealtite). Conduit will encase the load wires and ground wire from the safety disconnect switch to the blower motor. Conduit length not to exceed 4 feet (1219.2 mm) from disconnect to blower motor. The appropriate listed terminal fittings shall be used (per NEC Code 2008). (Using fan model select appropriate conduit size from attached Table 1-1).

J. Spark Resistant Blower: AMCA certified, designed and installed as a direct drive spark resistant blower (IMC code ref. 503.2) The motor shall meet current EPACT standards for energy savings. Fans utilizing steel impellers will not be accepted.

K. Optional Temperature Switch: One for each apparatus connected to the system. The temperature switch shall be of the snap disc type and adjustable from 90 degrees F (32 degrees C) to 130 degrees F (54 degrees C). It shall be mounted on the ductwork 2 inches (50.8 mm) above the pressure switch by drilling a 1 inch (25.4 mm) hole, sealing the switch with silicon sealant and securing with 2 tek screws. Electrical connection shall be made with terminals provided or solder less type such as Thomas & Betts part no. 14RB-2577 or equivalent.
L. **Pressure Switch:** One for each apparatus connected to the system. The pressure switch shall operate at a maximum of 24VAC, pre-calibrated at .18 in. of water column. Mounting shall be accomplished by drilling a 3/8 inch (9.5 mm) hole 3 inches 76.2 mm) above the riser bracket and to the left of the regulator and threading the switch into the duct. The electrical connections shall be made with a 0.020 inch (.5 mm) by 0.187 inch (4.8 mm) female quick disconnect terminals, such as Thomas & Betts part no. 14RBD-18277 or equivalent.

### 2.15 AIR MOVING DEVICES

**A. Centrifugal Fans:** Direct drive centrifugal type, high pressure, single width, single inlet as required or indicated. **Impeller Wheels:** Radial design or backward incline for performance, spark resistant and made of a non-ferrous material to prevent static electricity build up. The impeller shall be dynamically and statically balanced and of the non-overloading type to provide maximum efficiency while achieving quiet, vibration-free operation. The fan housing shall be manufactured from a epoxy powder coated galvanized steel or nonferrous material. The outlet configuration shall be top horizontal, bottom horizontal, or up-blast. The housing shall be capable of field reconfiguration in the event the mounting position needs to be changed for unforeseen reasons. For aesthetic reasons, the fan motor and assembly shall be mounted on a welded Type 304 stainless steel (ASTM A240/A240M) or epoxy powder coated steel mounting base to prevent rust stains on the exterior of the building. The fan housing and motor mounting hardware shall be Type 304 stainless steel (ASTM A240/A240M) for serviceability reasons.

**B. Fan Motor and Bearing:** All 1 horsepower (746 watts) to 15 horsepower (11190 watts) motors shall be totally enclosed fan cooled (TEFC) continuous duty rated. The motors shall be dual voltage where applicable. Motors built after October 27th, 1997 shall comply with the government mandated "Energy Policy and Conservation Act" (EPACT) as outlined by the Department of Energy. The bearings shall be self-aligned, ball bearing type permanently sealed and lubricated. The exhaust discharge outlet shall be in compliance with International Mechanical Code and ACGIH recommendations (min. of 36" above roofline). Air intakes, windows, cascade systems, prevailing currents, communication equipment and building aesthetics shall be considered in the final location of the fan.

1. **Teflon Shaft Seal:** The fan shaft shall be steel and rotate in a non-sparking TEFILON seal to prevent leakage and to prevent hot exhaust gases from coming into contact with the motor bearings.
2. **Variable Speed Drive:** The motor shall be compatible with a variable speed drive unit.

**C. Performance:** The delivered volume shall take into account all the static regain of vehicle engine exhaust (based on an airtight connection at the tailpipe), lengths of ductwork, elbows, branches, shut off, wyes, etc. which accumulate the static pressure at the field inlet. The manufacturer’s provided fan(s) shall be performance guaranteed.

1. **Fan Capacity:** The Fan Capacity shall be sized as such as to deliver the required CFM at each hose drop to which the vehicle is attached.
   a. The 4 inch (101.6 mm) hose system shall be designed to deliver a minimum of 500 CFM (2.9 M/Second) at a velocity of 5800 FPM (33.6 M/Second) at the hose and nozzle connection.
   b. The 5 inch (127 mm) hose system shall be designed to deliver a minimum of 750 CFM (4.4 M/Second) at a velocity of 5800 FPM (33.6 M/Second) at the hose and nozzle connection.
   c. The 6 inch (152.4 mm) system shall be designed to deliver a minimum of 1100 CFM (6.4 M/Second) at a velocity of 5800 FPM (33.6 M/Second) at the hose and nozzle connection.
2. Location: The preferable fan location shall be on the outside of the fire station as far away from any living quarters as possible so that firefighters would not be disturbed by the system activation. No blower fans shall be mounted inside the fire station. Silencers shall be provided when fan sound pressure level exceeds 64 dB.

2.16 DUCTWORK SYSTEM

A. Ductwork Type and Materials: UMC Class 2 or SMACNA Class II product conveying duct, meet or exceed criteria for construction and performance as outlined in Round Industrial Duct Construction Standards, SMACNA. Materials of construction unless otherwise specified for all ductwork and fittings shall be a minimum G-90 galvanized sheet metal (ASTM A653/A653M). Only when specified, Type 304 stainless steel (ASTM A240/A240M) shall be provided.

B. Ductwork Sizing and Gauges: Round pipe construction, with the range of available sizes not to exceed 10 inches (254 mm) in diameter. Duct gauge shall depend on diameter and a minimum operating pressure of 8 inches water gauge (1990 Pa). Acceptable Gauge and Reinforcement Requirements: Inner duct diameter 4 inches (101.6 mm) through 11 inches (279.4 mm) diameter shall be 22 gauge standard pipe (International Mechanical Code).

C. Ductwork Fittings: Round and have a wall thickness 2 gauges (one even gauge number) heavier than the lightest allowable gauge of the downstream section of duct to which they are connected (International Mechanical Code). Air Duct Branch Entrances: Factory fabricated fittings or factory fabricated duct /tap assemblies. Fittings: Constructed so that air streams converge at angles no greater than 45 degree (International Mechanical Code). All Seams: Continuous stitch welded and if necessary internally sealed to ensure air tightness. Turning elbows shall be stitch-welded and used for all diameters and pressures. They shall be fabricated of 24 gauge galvanized steel and constructed as two piece with continuous welded seam construction fittings similar to those provided by Lindab Inc. Tapered Body Fittings: Used wherever particular fallout is anticipated and where air flow is introduced to the transport duct manifold.

D. Ductwork Design Velocities: Minimum of 3500 FPM (20.3 M/Second) to 4000 FPM (23.2 M/Second) transport velocity. Capture Velocity: 5500 FPM (31.9 M/Second) to 6000 FPM (34.8 M/Second) to extract virtually 100 percent of the exhaust gases.

E. External Ductwork: Sized for the exact inlet and outlet of the exhaust fan blower. An exhaust rain cap shall be supplied and manufactured in accordance with EPA standard for free draft rain cap requirements. Included as an integral part of this rain cap shall be a back draft damper to provide protection from rain and other inclement weather.

F. Exhaust Penetrations: The core drilling shall be properly sized to reduce the diameter of the opening to the smallest possible size.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with the Installer present, for compliance with requirements for installation tolerances, service-utility connections, and other conditions affecting installation and performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Provide surface/substrate preparation as required by the manufacturer’s printed installation instructions. Do not proceed with installation is in proper condition to receive vehicle exhaust system installation.
3.03 INSTALLATION
   A. Install vehicle exhaust system in accord with manufacturer’s written instructions, original design and referenced standards.

3.04 ADJUSTING
   A. Adjust vehicle exhaust system for proper operation. Replace any parts that prevent the system from operating properly.

3.05 CLEANING
   A. Remove all debris caused by installation of the vehicle exhaust system. Clean all exposed surfaces to as fabrication condition and appearance.

3.06 PROTECTION
   A. Provide protection of the completed installation until completion of the project. Repair any damage at no additional cost to Owner.

3.07 TRAINING
   A. Provide training to fire department personnel in the daily use and maintenance of the vehicle exhaust removal system that has been installed and specified herein. The fire department shall be notified at least 7 days prior to the date scheduled for the training course. Training shall be for all personnel involved with the operation of the exhaust removal system to include all shifts required to man the particular facility. The Training session shall be performed in person by a recognized representative of the manufacturer of the exhaust removal system, in addition a training video shall be provided to the fire department.

END OF SECTION 23 3750
PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes breechings, chimneys and stacks for use with unit heaters and water heaters.

1.2 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “Basic Mechanical Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.3 SUBMITTALS
A. Product Data: Submit product data for each of the following:
   1. Each type of breeching, chimney and/or stack specified herein.
   2. Guy wires and connectors.
   3. Each type of accessory, such as thimbles, termination caps, expansion fittings, guides, anchors, etc.
B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers, and location and size of each field connection.
C. Shop Drawings: Show fabrication and installation details for fans and dampers. Include plans, elevations, sections, details, and attachments to other work. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, hangers and seismic restraints, and location and size of each field connection. Provide wiring diagrams for power, signal, and control wiring.

1.4 QUALITY ASSURANCE
A. Source Limitations: Obtain listed system components through one source from a single manufacturer.
B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.
C. UL Compliance: Furnish and install only breechings, chimneys, and stacks that are certified according to UL 1738 Standard for Venting Systems for Gas-Burning Appliances, unless noted otherwise.

1.5 COORDINATION
A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section “Roof Accessories.”

1.6 WARRANTY
A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, structural failures caused by expansion and contraction. Warranty period shall be a minimum of 10-years from date of Substantial Completion, for all products specified herein.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Breechings, Chimneys and Stacks: Subject to compliance with requirements, provide Listed Breechings, Chimneys and Stacks and accessory products by one of the following:
   1. DuraVent, Inc.
   2. HeatFab by Selkirk Corp.
   3. The Schebler Co.

2.2 LISTED TYPE B VENTS

A. Description: Double-wall metal vents certified under UL 1738 and rated for 480°F (248°C) continuously for Type B; with neutral or negative flue pressure complying with NFPA 211.
   B. Construction: Inner shell and outer jacket separated by at least ¼-inch (6-mm) airspace.
   C. Inner Shell: ASTM B 209, Type 1100 or Type 3003 aluminum.
   D. Outer Jacket: Galvanized or aluminized steel.
   E. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.
   F. Termination: Factory round chimney top designed to exclude minimum 98 percent of rainfall.
   G. Termination: Factory exit cone with drain section incorporated into riser.
   H. Termination: Factory miter cut section with bird screen for sidewall termination.
   I. May be used for unit heater and water heater combustion air and flue exhaust only.

2.3 LISTED SPECIAL GAS VENTS

A. Description: Double-wall metal vents certified under UL 1738 and rated for 480°F (248°C) continuously, with positive or negative flue pressure complying with NFPA 211. Minimum static pressure rating of 10-inch water column.
   B. Construction: Inner shell and outer jacket separated by at least 1-inch (25-mm) airspace. All longitudinal seams shall be full penetration welded for the entire length.
   C. Transverse Joints: Manufacturer’s high-temperature factory gasket system used in conjunction with banded flanges or gasketed couplings rated for same pressure and temperature as primary vent product, required as part of UL Listing. A field-installed wet-applied sealant is not acceptable.
   D. Inner Shell: ASTM A959, Type AL29-4C stainless steel, 24-gauge minimum thickness.
   E. Outer Jacket: Type 316 stainless steel, 22-gauge minimum thickness. Include stainless steel standoffs or spacer clips that maintain the concentricity of the annular space between inner and outer walls.
   F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.
   G. Termination: Factory round chimney top designed to exclude minimum 98 percent of rainfall.
   H. Termination: Factory exit cone with drain section incorporated into riser.
   I. Termination: Factory miter cut section with bird screen for sidewall termination.
   J. May be used for gas furnace (condensing).
2.4 GUYING AND BRACING MATERIALS

A. Cable: Four galvanized, stranded wires of the following thickness:
   1. Minimum Size: 1/4-inch (6 mm) in diameter.
   2. For ID Sizes 4 to 15 Inches (100 to 381 mm): 5/16-inch (8 mm).
   3. For ID Sizes 18 to 24 Inches (457 to 610 mm): 3/8-inch (9.5 mm).
   4. For ID Sizes 27 to 30 Inches (685 to 762 mm): 7/16-inch (11 mm).
   5. For ID Sizes 33 to 36 Inches (838 to 915 mm): 1/2-inch (13 mm).
   6. For ID Sizes 39 to 48 Inches (990 to 1220 mm): 9/16-inch (14.3 mm).
   7. For ID Sizes 51 to 60 Inches (1295 to 1524 mm): 5/8-inch (16 mm).

B. Pipe: Three galvanized steel, NPS 1¼ (DN 32).

C. Angle Iron: Three galvanized steel, 2 by 2 by 0.25-inch (50 by 50 by 6 mm).

PART 3 - EXECUTION
3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SCHEDULE OF APPLICATIONS

A. Listed Type B Vents: Use with atmospheric gas-fired non-condensing appliances.

B. Listed Special Gas Vent: Use with condensing gas-fired appliances.

3.3 INSTALLATION OF LISTED VENTS AND CHIMNEYS

A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

C. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

D. Lap joints in direction of flow.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 23 5100
PART 1 - GENERAL

1.01 SUMMARY
A. This Section includes split-system air-conditioning units 5-tons and smaller, consisting of separate evaporator-fan and compressor-condenser components.
   1. Gas-fired, condensing furnaces and accessories complete with controls.
   2. Air-cooled condensing units suitable for grade mounting.
   3. Horizontal indoor evaporator cooling coils.
   4. Thermostat.

1.02 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “Basic Mechanical Materials and Methods” all apply to the work of this Section as if fully repeated herein.

1.03 SUBMITTALS
A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties and accessories. Include performance data in terms of capacities, equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, static pressures, sound power characteristics, motor requirements, electrical characteristics, and location and size of each field connection.
B. Shop Drawings: Detail fabrication including anchorages and attachments to structure and to supported equipment.
C. Wiring Diagrams: For power, signal, and control wiring.
D. Field quality-control reports.
E. Operation and Maintenance Data: For gas-fired furnace, air-cooled condensing unit and indoor evaporator cooling coil to include in emergency, operation, and maintenance manuals.
F. Warranty: Sample of special warranty.

1.04 QUALITY ASSURANCE
A. Product Options: Drawings indicate size, profiles, and dimensional requirements of the equipment and are based on the specific systems indicated. Refer to Division 23 Section “Basic Mechanical Requirements.”
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
C. AHRI Compliance: All split-system units shall be rated in accordance with Air-conditioning Heating Refrigeration Institute’s (AHRI) Standard 210 and bear the AHRI Certification label.
F. Energy Compliance: No condensing unit and/or split-system will be accepted which does not meet Table 6.8.1 values in ASHRAE Standard 90.1-2016 Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.05 COORDINATION
A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Sections.
B. Coordinate location of piping and electrical rough-ins.

1.06 PRODUCT STORAGE AND HANDLING
A. Store gas-fired furnace, air-cooled condensing unit, indoor evaporator cooling coil and field piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed. All unit openings shall be tightly covered with shrink-wrap or similar means to protect against moisture, dirt, and dust penetration throughout delivery, storage, shipping, and handling.
B. Lift and support units with manufacturer’s designated lifting or supporting points.

1.07 WARRANTY
A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of gas-fired, condensing furnace; air-cooled condensing unit and horizontal indoor evaporator cooling coil that fail in materials or workmanship within twenty (20) years from date of Substantial Completion. Failures include, but are not limited to, compressor failure, heat exchanger and/or refrigerant coil leak.

1.08 EXTRA MATERIALS
A. Furnish one additional complete set of filters for each unit that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS
2.01 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
   1. Carrier Corporation, a United Technologies Company.
   2. Daikin Applied Americas Inc.
   3. Goodman Manufacturing Company

2.02 GAS-FIRED, CONDENSING FURNACE (HORIZONTAL CONFIGURATION)
A. Cabinet: 20-gauge, galvanized steel with appliance finish.
   1. Cabinet interior around heat exchanger and blower shall be factory installed insulation.
   2. Lift-out panels shall expose burners and other items requiring access for maintenance.
   3. Factory paint external cabinets in manufacturer’s standard color.
   4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
B. Fan: Centrifugal, factory balanced, resiliently mounted, direct drive. Quiet variable-speed induced draft blower.
   1. Fan Motors: Comply with requirements in Section 230513 Motors.”
      a. Motor shall be ECM, Electronically controlled motor (ECM) controlled by integrated furnace blower control.
C. Type of Gas: Natural.
D. Annual Fuel Utilization Efficiency (AFUE) minimum: 97-percent heating efficiency.
E. Heat Exchanger:
   1. Primary: Heavy duty tubular stainless steel.
F. Burner:
   1. Gas Valve: 100 percent safety self-calibrating modulating main gas valve auto-
                  configure for each installation, main shutoff valve, pressure regulator, safety pilot
                  with electronic flame sensor, limit control, transformer, and combustion ignition /
                  fan control board.
   2. Ignition: Silicon nitride hot-surface ignition system.
G. Gas-Burner Safety Controls:
   1. Electronic Flame Sensor: Prevents gas valve from opening until pilot flame is
                  proven; stops gas flow on ignition failure.
   2. Flame Rollout Switch: Installed on burner box; prevents burner operation.
   3. Limit Control: Fixed stop at maximum permissible setting; de-energizes burner
                  on excessive bonnet temperature; automatic reset.
H. Combustion-Air Inducer: Centrifugal fan with thermally protected motor and sleeve
   bearings prepurges heat exchanger and vents combustion products; pressure switch
   prevents furnace operation if combustion-air inlet or flue outlet is blocked.
I. Furnace Controls: Solid-state board integrates ignition, heat cooling and fan speeds,
   adjustable fan-on and fan-off timing; terminals for connection to accessories; diagnostic
   light with viewport.
J. Condensate Drain Pans: Single-wall, stainless-steel sheet, fabricated with not less than
   one-percent slope in at least two planes to collect condensate from cooling coils
   (including coil piping connections, coil headers, and return bends), and to direct water
   toward drain connection. Drain connection shall be located at lowest point of pan and
   sized to prevent overflow. Terminate with threaded nipple on one end of pan.

2.03 AIR-COOLED CONDENSING UNITS SUITABLE FOR GRADE MOUNTING
A. Description: Factory assembled and tested, air cooled, consisting of casing, scroll
   compressors, condenser coils, condenser fans and motors, and unit controls.
B. Compressors: Positive displacement, scroll-type, direct drive with suction and discharge
   service valves, internal overcurrent and high-temperature protection, internal pressure
   relief, crankcase oil heater, and suction strainer. The compressor shall be capable of
   operating at part-load conditions without increased vibration over normal vibration at full-
   load operation and shall be capable of continuous operation at its lowest step of
   unloading.
   1. Compressor Casing: Hermetically sealed casing.
   2. Operating Speed: Nominal 3600 rpm for 60 Hz applications.
   4. Vibration Isolation: Resiliently-mount individual compressors to unit frame.
   5. Compressor Motors: Hermetically sealed and cooled by refrigerant suction gas.
      High-torque, two-pole induction type with inherent thermal-overload protection on
      each phase.
   6. Reciprocating compressors will not be accepted.
   7. High-density compressor sound blanket.
C. Compressor Variable Speed Controllers: Solid State, NEMA ICS 2, listed and labeled as
   a complete unit and arranged to provide variable speed by adjusting output voltage and
   frequency; factory assembled and tested prior to shipment.
1. Output: 3-phase, 6 to 60 Hz, with voltage proportional to frequency throughout range.
2. Pulse-width modulated (PWM) waveform with full-wave rectifier, DC bus choke, and DC bus capacitors.
3. 1200-7200 rpm speed range.
4. Protection and fault LED codes for diagnostics and troubleshooting.
5. Stator heating capability.
6. Finned (air cooled) or flat plate (refrigerant cooled) heat sink.
7. Dedicated compressor menu structure and parameters for setup.
8. System integration module slots for additional I/O.
9. Locked rotor detection.
10. Phase protection and correction.
11. Maximum operating current detection.
12. Discharge line temperature protection.
13. Anti-short cycling.

D. Refrigerant Compatibility: Seals, O-rings, motor windings, and internal parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.

E. Refrigerant Circuit: At least two independent circuits are required. Each circuit shall include an electronic expansion valve, refrigerant charging connections, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter drier, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line, all of which are specified elsewhere.

F. Condenser Coil: Seamless copper-tube, aluminum-fin coil, including subcooling circuit and backseating liquid-line service access valve. Factory pressure test coils, then dehydrate by drawing a vacuum and fill with a holding charge of nitrogen or refrigerant.
1. Coil Casing: Same as cabinet construction. Isolate copper tubing from contact with steel casing members by using polymer strip or other non-conducting insulator material.
2. Circuit Arrangement: Circuit for interleaved capacity control.
4. Tubes: Copper complying with ASTM B75, 1/2-inch O.D. with 0.016-inch minimum wall; or 5/8-inch O.D. with 0.020-inch minimum wall.
5. Fins: Aluminum of minimum thickness 0.006-inch. Spacing shall not exceed 12 per inch.
6. Fin and Tube Joint: Mechanical bond created via thermal expansion.
7. Suction and Distributor: Seamless copper tube with brazed joints, with equalizing-type vertical distributor.
8. Ratings: Design, test and rate according to ASHRAE 33 and AHRI 410.

G. Condenser Fans: Propeller-type vertical discharge; direct-drive. Cast aluminum, with blades mounted on cast-iron wheel plate keyed to shaft with solid-steel key. Include the following:
1. Permanently lubricated ball-bearing motors.
2. Separate motor for each fan.
3. Dynamically and statically balanced fan assemblies.
4. Fan Hub and Blade-Bearing Assemblies: Cast aluminum, machined and fitted with threaded bearing wells to receive blade-bearing assemblies.
5. Blades: Replaceable, cast aluminum; factory mounted and balanced to hub assembly.

6. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of first critical speed at top of fan’s speed range.

7. Prelubricated and sealed-type ball bearings meeting the above requirements will also be acceptable.

8. Bearing Rating Life: ABMA 9, \( L_{10} \) of 40,000 hours.

9. Fan Motors: Comply with requirements in Section 230513 Motors.”
   a. Motor shall be ECM, Electronically controlled motor (ECM) controlled by integrated furnace blower control.

H. Operating and safety controls shall include the following:
   1. Manual-reset, high-pressure cutout switches.
   2. Automatic-reset, low-pressure cutout switches.
   3. Low oil pressure cutout switch.
   4. Compressor-winding thermostat cutout switch.
   5. Three-leg, compressor-overload protection.
   6. Control transformer.
   7. Magnetic contactors for compressor and condenser fan motors.
   8. Timer to prevent excessive compressor cycling.

I. Unit Casings: Designed for outdoor installation with weather protection for components and controls and with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features shall include the following:
   1. Steel, galvanized or zinc coated, for exposed casing surfaces, treated and finished with manufacturer’s standard paint coating.
   2. Perimeter base rail with forklift slots and lifting holes to facilitate rigging.
   3. Gasketed control panel door.
   4. Nonfused disconnect switch, factory mounted and wired, for single external electrical power connection.
   5. Condenser coil hail guard to protect coil from physical damage.

J. Motors: General requirements for motors are specified in Division 23 Section “Motors.”
   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: Electrical devices and connections are specified in Division 26 Sections.

2.04 HORIZONTAL INDOOR EVAPORATOR COOLING COILS

A. Encased horizontal design, painted case, factory installed electronic expansion valve, with easy maintenance as the coil slides out of the cabinet after removing the access door and service panel.

B. Cabinet: 20-gauge, galvanized steel with appliance finish. Horizontal design.
   1. Cabinet interior shall be completely factory installed insulation.
   2. Lift-out panels shall expose cooling coil and other items requiring access for maintenance.
   3. Factory paint external cabinets in manufacturer’s standard color.
   4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Coil:
   1. Tubes: Copper complying with ASTM B75, ½-inch O.D. with 0.016-inch minimum wall.
2. Fins: Aluminum of minimum thickness 0.006-inch. Spacing shall not exceed 12 per inch.
3. Fin and Tube Joint: Mechanical bond created via thermal expansion.
4. Suction and Distributor: Seamless copper tube with brazed joints.
5. Frames: Stainless Steel, 0.0625 inch (1.58 mm).
6. Ratings: Designed, tested and rated according to ASHRAE 33 and ASHRAE 410.
7. Working-Pressure Ratings: 300 psig (2070 kPa), 325°F (163°C).
8. Source Quality Control: Test to 450 psig (3110 kPa) and to 300 psig (2070 kPa) underwater.

D. Condensate Drain Pan: Corrosion-resistant condensate drain pan. The condensate drain pan designed with a slope to the drain connection.

E. Factory installed electronic expansion valve (EEV).

F. Unit connects directly to the gas furnace.

2.05 THERMOSTAT

A. Provide thermostat capable of controlling gas-fired condensing furnace, air cooled condensing unit and horizontal indoor evaporator coil all in one. Thermostat shall be Daikin One+ or approved equal.

B. Combination Thermostat and Fan Switches: Line-voltage thermostat with analog dial, capacitive touch screen, push-button and/or lever-operated fan switch.
   1. Label switches.
   2. Mount on single electric switch box.

C. Electric, solid-state, microcomputer-based room thermostat with remote sensor.
   1. Automatic switching from heating to cooling.
   2. Preferential rate control to minimize overshoot and deviation from set point.
   3. Set up for four separate temperatures per day.
   4. Instant override of set point for continuous or timed from 1 hour to 31 days.
   5. Short-cycle protection.
   6. Programming based on every day of the week.
   7. Selection features include °F or °C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
   8. Backlit, 3.5 inch LCD display.
   9. Bi-directional communications protocol for controlling HVAC system.

D. Battery replacement without program loss.

E. Thermostat display features include the following:
   a. Time of day.
   b. Actual room temperature.
   c. Programmed temperature.
   d. Programmed time.
   e. Duration of timed override.
   f. Day of week.
   g. System mode indications include “heating,” “off,” “fan auto,” and “fan on.”

F. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85°F (13 to 30°C) set-point range, and 2°F (1°C) maximum differential.

G. An integrated WiFi radio connects to the internet (via home router) to the cloud and on to the User mobile application.
2.06 CAPACITIES AND CHARACTERISTICS
A. Capacities and characteristics are scheduled on the Drawings.

2.07 SOURCE QUALITY CONTROL
A. Verification of Performance: Rate condensing units according to AHRI 2100/240 and/or AHRI 340/360 as applicable to unit capacity.
B. Test and inspect shell and tube condensers according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
C. Testing Requirements: Factory test sound power-level ratings according to AHRI 270.

PART 3 - EXECUTION
3.01 EXAMINATION
A. Examine walls, floors, and grade for suitable conditions where equipment will be installed. Examine substrates, areas, and conditions, for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
B. Examine factory-installed insulation before installation. Reject units that are wet, moisture damaged, or mold damaged.
C. Examine roughing-in for gas and refrigerant piping systems to verify actual locations of piping connections before equipment installation.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION
A. Install units level and plumb, and in accordance with manufacturer’s written installation instructions. Set equipment supports so top surface of equipment is level. Firmly anchor in locations indicated. Maintain manufacturer’s recommended clearances.
B. Install evaporator and compressor-condenser components using manufacturer’s standard mounting devices securely fastened to building structure.
C. Install ground-mounted, compressor-condenser components on 4-inch- (100-mm-) thick, reinforced concrete base that is 4 inches (100 mm) larger, on each side, than unit. Concrete, reinforcement, and formwork are specified in Division 03 Section “Cast-in-Place Concrete.” Coordinate anchor installation with concrete base.
D. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.
E. Install gas-fired furnaces and accessories fuel and vent features and systems according to NFPA 54.
F. Suspended Units: Suspend from structure using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.
G. Controls: Install thermostats at mounting height of 60 inches (1500 mm) above finished floor or approved by Architect.
H. Wiring Method: Install control wiring in accessible ceiling spaces.

3.03 CONNECTIONS
A. Install piping adjacent to machine to allow service and maintenance.
B. Connect refrigerant piping to air-cooled condensing units, maintain required access to unit. Install furnished field-mounted accessories.
C. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
1. Install and connect pre-charged refrigerant tubing to component’s quick-connect fittings. Install tubing to allow access to unit. If manufacturer’s pre-charged refrigerant tubing is of insufficient length, field-provide copper ACR refrigeration tubing with brazed joints.

2. Condensate Drain: Plastic drain hose is not acceptable. Field-furnish and install copper DWV piping.

3. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

D. Gas piping installation requirements are specified in Section 226323 “Natural Gas Piping.”

E. Duct Connections: Duct installation requirements are specified in Division 23 Section “Metal Ducts” Drawings indicate the general arrangement of ducts. Connect supply ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section “Duct Accessories.”

F. Insulate all field piping and ductwork as further specified in Division 23 Section “Mechanical Insulation.”

G. Connect wiring and ground equipment in accordance with Division 26 Sections.

H. Furnish and install signal and control wiring, including but not limited to interconnection between condensing unit associated evaporator unit, as the work of this Section but meeting all applicable requirements of Division 23 Section “HVAC Instrumentation and Controls.”

3.04 FIELD PIPING

A. Copper Tube: ASTM B280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Suction Lines, Hot-Gas and Liquid Lines: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

F. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

G. Condensate Drain: DWV Copper Tubing, ASTM B306.

H. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

I. Install refrigerant piping according to ASHRAE 15.

J. Install piping adjacent to machines to allow service and maintenance.

K. Install piping free of sags and bends.

L. Install fittings for changes in direction and branch connections.

M. Select system components with pressure rating equal to or greater than system operating pressure.

N. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

O. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection.

P. 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.

Q. When soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

S. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

T. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

U. Soldered Joints: Construct joints according to ASTM B 828 or CDA’s Copper Tube Handbook.

V. Hanger, support, and anchor products are specified in Division 23 Section “Hangers and Supports.”

3.05 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.06 ADJUSTING

A. Adjusting high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

B. Adjust set-point temperature of air-conditioning controllers to the system design temperature.

C. Perform the following adjustments before operating the refrigeration system, according to manufacturer’s written instructions:

1. Verify that compressor oil level is correct.
2. Open compressor suction and discharge valves.
3. Open refrigerant valves except bypass valves that are used for other purposes.
4. Check open compressor-motor alignment and verify lubrication for motors and bearings.

D. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

3.07 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Perform electrical test and visual and mechanical inspection.
2. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Verify proper airflow over coils.
B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

C. Remove and replace malfunctioning condensing units and retest as specified above.

D. Field Piping Pressure Test: Coordinate with specific refrigerant to be provided; then comply with the following.
   1. Comply with ASME B31.5, Chapter VI.
   2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
   3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated below.
   4. Fill system with nitrogen to the required test pressure. System shall maintain test pressure at the manifold gage throughout duration of test.
   5. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
   6. Line Test Pressure for Refrigerant R-410A:
      a. Suction Lines: 300 psig (2068 kPa).

3.08 STARTUP SERVICE

A. Complete installation and startup checks according to manufacturer’s written instructions and perform the following:
   1. Inspect for physical damage to unit casing.
   2. Verify that access doors move freely and are weathertight.
   3. Clean units and inspect for construction debris.
   4. Verify that all bolts and screws are tight.
   5. Adjust vibration isolation and flexible connections.
   6. Verify that controls are connected and operational.

B. Lubricate bearings on fans. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

C. Start unit according to manufacturer’s written instructions and complete manufacturer’s startup checklist.

D. Measure and record airflow over coils. Verify proper operation of condenser capacity control device. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

3.09 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain condensing units. Refer to Division 01.

END OF SECTION 23 8126
PART 1 - GENERAL

1.01 SUMMARY
A. Section includes propeller gas-fired unit heaters.

1.02 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 23 0100 “Basic Mechanical Requirements,” and Section 23 0500 “Basic Mechanical Materials and Methods” all apply to the work of this Section as if fully repeated herein.
C. The following Sections contain requirements that relate to this Section:
   1. Division 22 Section “Natural Gas Piping” for fuel supply to gas-fired unit heaters.
   2. Division 23 Section “Hangers and Supports” for support, product descriptions, and installation requirements.
   3. Division 23 Section “Breechings, Chimneys and Stacks” for combustion and flue exhaust vents associated with gas-fired unit heaters.

1.03 SUBMITTALS
A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties, and accessories. Include plans, elevations, sections, details, and attachments to other work. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
B. Wiring Diagrams: For power, signal, and control wiring.
C. Warranties: Sample of special warranties.
D. Operation and Maintenance Data: For gas-fired unit heaters to include in maintenance manuals.

1.04 QUALITY ASSURANCE
A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - “Systems and Equipment” and Section 7 - “Construction and Startup.”
B. Airstream Surfaces: All surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - “Heating, Ventilating, and Air-Conditioning.”
D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
E. UL Compliance: Test gas-fired unit heater for compliance with UL 795 Commercial-Industrial Gas Heating Equipment. Unit heater shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.
F. ETL design certification for use in both the US and Canada to the ANSI Z83.8 – latest revision, standard for “Gas-Fired Duct Furnaces” for safe operation, construction, and performance.

1.05 WARRANTY
A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of gas-fired unit heater that fail in materials or workmanship within specified warranty period.
1. Warranty Period (Non-heating Units): 24 months after date of substantial completion.
2. Warranty Period (Heating Units): 18 months after date of substantial completion.

PART 2 - PRODUCTS

2.01 MANUFACTUERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Markel Products; a division of TPI Corporation.
   2. Sterling HVAC Products – A Mestek, Inc.
   3. Reznor HVAC Equipment.

2.02 GAS-FIRED UNIT HEATERS

A. Furnace section with 82% minimum efficiency provided by an indirect-fired tubular heat exchanger with individually fired tubes.

B. Venting Arrangement: The unit shall be separated combustion. The venting shall be a power exhausted arrangement with a separate combustion air intake pipe connection to allow for fresh combustion air from outside the conditioned space. The unit shall be tested to insure proper ignition when the unit is subjected to 40 mile per hour wind velocities. The unit shall also include a factory mounted differential pressure switch designed to prevent main burner ignition until positive venting has been proven.

C. Unit Casing:
   1. The unit heaters casing shall be constructed of not less than 20 gauge aluminized steel with minimization of exposed fasteners.
   2. All exterior casing parts shall be cleaned of all oils and a phosphate coating applied prior to painting. All exterior casing parts shall be painted with an electrostatically applied baked-on polyester powder paint (7-mil thickness) for corrosion resistance.
   3. The unit shall be furnished with horizontal air deflectors. The deflectors are adjustable to provide for horizontal directional airflow control (up or down).

D. Furnace Section:
   1. The heat exchanger shall be made of 18-gauge aluminized steel tubes and headers. The thermal efficiency of the unit shall be a minimum of 82% efficient for all air flow ranges. Each heat exchanger tube shall be individually and directly flame-fired. The heat exchanger tube shall be crimped to allow for thermal expansion and contraction. The flue collector box shall be made of 20-gauge aluminized steel.
   2. The heat exchanger:
      a. 316 stainless steel construction.
   3. The ignition controller shall be 100% shut-off with continuous retry.
   4. The gas pressure shall be between 6-7-inch W.C. for natural gas.
   5. The solid state ignition system shall directly light the gas by means of a direct spark igniter each time the system is energized.
   6. Single-stage gas controls with a single-stage combination gas control, an ignition control, and a single-stage low voltage thermostat. The unit fires at 100% full fire based on a call for heat from the unit mounted thermostat.
   7. An automatic reset high limit switch mounted in the air stream to shut off the gas supply in the event of overheating.
   8. A time delay relay that delays the start of the air mover to allow the heat exchanger a warm-up period after a call for heat. The time delay relay shall also continue the air mover operation after the thermostat has been satisfied to remove any residual heat in the heat exchanger.
E. **Electrical:**
   1. All electrical components shall carry UL, ETL, or CSA listing.
   2. A low voltage terminal board shall be provided for direct wiring connection to an external thermostat.
   3. A single 115V to 24V step down transformer shall be provided for unit controls.

F. **Air Mover:**
   1. The motor wiring shall be flexible metal BX conduit.
   2. The motor shall be controlled by a time delay relay.
   3. The motor type shall be single-speed, totally enclosed.
   4. The motor shall be rated for 115V/60Hz/1Ph.
   5. Built-in disconnect switch (20A @ 115V Rating).

G. **Required Accessories:**
   1. Integrated circuit board with diagnostic indicator lights.
   2. Multi-try direct ignition with timed lockout.
   3. Fan relay (included on the circuit board).
   5. Fully gasketed door panel with safety door switch.
   6. Vertical combustion air/vent kit including concentric adaptor.
   7. Unit mounted thermostat.
   8. Vertical louvers.
   9. Ceiling suspension kit.
   10. Provide concentric adapter box for combustion air and double wall exhaust flue to connect to. Provide attaching brackets for roof mount and side wall mount applications.
   11. Provide horizontal venting kit for one (1) unit heater. This shall include concentric adapter box, brackets and vent/combustion air terminal. Similar to Reznor option CC14.

**PART 3 - EXECUTION**

### 3.01 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine roughing-in for gas piping systems to verify actual locations of piping connections before gas-fired unit heater installation.

C. Examine structures, substrates, areas and conditions for compliance with requirements for installation tolerances, required clearances, and other conditions affecting performance of the Work. Examine roughing-in for fuel-gas piping to verify actual locations of piping connections detrimental to performance of the Work. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

A. Install air curtains with clearance for equipment service and maintenance.

B. Comply with requirements for hangers and supports specified in Division 23 Section “Hangers and Supports.”

C. Adjust motor and fan speed to achieve specified airflow. Adjust discharge nozzle to regulate airflow. Adjust air-directional vanes.

D. Install valves, unions, fittings, and other specialty items as indicated by detail on the Drawings.

E. Install piping adjacent to machine to allow service and maintenance.

F. Comply with safety requirements of UL 1995.
G. Connect wiring and ground equipment according to Division 26 Sections.
H. Equipment Installation: Install gas-fired, unit heater and associated features and systems according to NFPA 54.
I. Maintain manufacturer’s recommended clearances for combustibles.

3.03 CONNECTIONS
A. Gas Piping: Comply with Division 22 Section “Natural-Gas Piping”. Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service. Connect piping to unit heater according to NFPA 54.
B. Connect piping. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
C. Venting: Comply with applicable requirements in Division 23 Section “Breechings, Chimneys, and Stacks.” Connect breeching to full size at flue outlet.

3.04 FIELD QUALITY CONTROL
A. Perform tests and inspections as follows:
   1. After installing gas-fired unit heater completely, perform visual and mechanical check of individual components.
   2. After electrical circuitry has been energized, start unit to confirm motor rotation and unit operation. Certify compliance with test parameters.
   3. Test gas train and verify that there are no gas leaks.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
B. Gas-fired unit heater shall be considered defective if it does not pass tests and inspections.
C. Prepare test and inspection reports.

3.05 DEMONSTRATION
A. Train Owner’s maintenance personnel to adjust, operate, and maintain gas-fired unit heater.

END OF SECTION 23 8239
SECTION 26 0500
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Common electrical installation requirements.

1.3 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

E. Coordinate sleeve selection and application and installation as specified in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves as specified in Division 26 Section “Sleeves and Sleeve Seals for Electrical Raceways and Cabling.”

3.3 SLEEVE-SEAL INSTALLATION

A. Install sleeve-seals as specified in Division 26 Section “Sleeves and Sleeve Seals for Electrical Raceways and Cabling.”

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical raceway and cabling installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 26 0500
SECTION 26 0519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes the following:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS
A. EPDM: Ethylene-propylene-diene terpolymer rubber.
B. NBR: Acrylonitrile-butadiene rubber.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS
A. Field quality-control test reports.

1.6 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with NFPA 70.
PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alcan Products Corporation; Alcan Cable Division.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN or THWN-2. (Minimum insulation rating is 90° C).

D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, HOSPITAL GRADE Type MC with ground wire. (To be used only as dedicated light fixture whips from junction box to fixture with a maximum length of 6ft and for circuits in existing walls).

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

1. Minimum size conductor shall be #12 AWG.
3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN-2, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN-2, single conductors in raceway.

D. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN-2, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN-2, single conductors in raceway.
   1. Metal-clad cable, Type MC cable is only allowed for lighting fixture whips up to 6'-0” long. They must be dedicated whips.

F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

G. Class 1 Control Circuits: Type THHN-THWN, in raceway.

H. Class 2 Control Circuits: Type THHN-THWN-2, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

END OF SECTION 26 0519
SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes: Grounding systems and equipment.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Field quality-control reports.

1.4 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS
A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
B. Bare Copper Conductors:
   4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
   5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
   7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
C. Grounding Bus: Predrilled rectangular bars of annealed copper, **1/4 by 4 inches** in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

### 2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
   1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless **compression**-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

E. Cable to Cable Connectors: Compression type, copper or copper alloy.

F. Conduit Hubs: Mechanical type, terminal and threaded hub.

G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

### 2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, sectional type; 3/4" inch by 10 Feet

### PART 3 - EXECUTION

#### 3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Grounding Bus: Install in telecom equipment room as indicated on drawings.
   1. Install bus horizontally, on insulated spaces 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
   2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

C. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.

3.2 GROUNDING AT THE SERVICE (EXISTING TO REMAIN)

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses. (Contractor shall verify that this is existing at the service)

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120V 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.

C. 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.

D. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

E. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. 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.

2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.

3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

3.5 LABELING

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.

1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

END OF SECTION 26 0526
SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.
B. IMC: Intermediate metal conduit.
C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Equipment supports.

B. Welding certificates.
1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of Cooper Industries.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut; Tyco International, Ltd.
      g. Wesanco, Inc.
   2. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   3. Channel Dimensions: Selected for applicable load criteria.
B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
D. Support 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.
E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cooper B-Line, Inc.; a division of Cooper Industries.
2) Empire Tool and Manufacturing Co., Inc.
3) Hilti Inc.
4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
5) MKT Fastening, LLC.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

C. 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:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: **Beam clamps (MSS Type 19, 21, 23, 25, or 27)** complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. 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**.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 PAINTING

A. Touchup: Comply with requirements in Division 09 **painting Sections** for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION 26 0529**
SECTION 26 0533
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS
A. EMT: Electrical metallic tubing.
B. FMC: Flexible metal conduit.
C. IMC: Intermediate metal conduit.
D. LFMC: Liquidtight flexible metal conduit.
E. LFNC: Liquidtight flexible nonmetallic conduit.

1.4 SUBMITTALS
A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
   1. Surface Raceways.
C. Source quality-control test reports.

1.5 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with NFPA 70.
PART 2 - PRODUCTS

2.1  METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Allflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
7. Maverick Tube Corporation.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

   1. Comply with NEMA RN 1.
   2. Coating Thickness: 0.040 inch, minimum.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

   2. Fittings for EMT: Die-cast compression type.
   3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2  METAL WIREWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.
B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type.

E. Finish: Manufacturer's standard enamel finish.

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
7. RACO; a Hubbell Company.
10. Spring City Electrical Manufacturing Company.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

G. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: **Rigid steel conduit**.
2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): **LFMC**.
3. Boxes and Enclosures, Aboveground: **NEMA 250, Type 3R**.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: **EMT**
2. Exposed, Not Subject to Severe Physical Damage: **EMT**.
3. Exposed and Subject to Severe Physical Damage: **Rigid steel conduit**. Includes raceways in the following locations:
   a. Mechanical rooms on walls below 7’ AFF.
4. Concealed in Ceilings and Interior Walls and Partitions: **EMT**.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): **FMC**, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: **Rigid steel conduit**.
7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: **EMT**
8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: **EMT**
9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: **EMT**
10. Boxes and Enclosures: **NEMA 250, Type 1**, except use **NEMA 250, Type 4**, **stainless steel** in damp or wet locations.

C. Minimum Raceway Size: **3/4-inch** trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

E. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.
D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

K. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
   1. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
   2. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where otherwise required by NFPA 70.

M. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet.
   1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
      a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
      b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
      c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.
      d. Attics: 135 deg F temperature change.
   2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

N. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semi recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

O. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Refer to Division 26 Section “Sleeves and Sleeve Seals for Electrical Raceways and Cabling.” For sleeve specification and application.

3.4 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.5 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 0533
SECTION 26 0544
SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
   2. Grout.
B. Related Requirements:
   1. Division 07 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES
A. Wall Sleeves:
   2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
C. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
D. Sleeves for Rectangular Openings:
2. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
   b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 GROUT
   A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
   C. Design Mix: 5000-psi, 28-day compressive strength.
   D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS
   A. Comply with NECA 1.
   B. Comply with NEMA VE 2 for cable tray and cable penetrations.
   C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
      1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
         a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
         b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
      2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
      3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
      4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
      5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
   D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

END OF SECTION 26 0544
SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Identification for raceways.
   2. Identification of power and control cables.
   3. Identification for conductors.
   4. Warning labels and signs.
   5. Instruction signs.
   7. Miscellaneous identification products.

1.3 SUBMITTALS
A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE
A. Comply with ANSI A13.1.
B. Comply with NFPA 70.
D. Comply with ANSI Z535.4 for safety signs and labels.
E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION
A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. **Black letters on an orange field**
2. Legend: Indicate voltage **and system or service type**.

C. Colors for Raceways Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch high letters on 20-inch centers.

D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Furnish conduit identification for each conduit longer than six (6) feet.

F. Spacing: 20 feet on center. Starting within 12" of panelboards and continuing 20ft on center including both sides of any penetration, thru point of termination.

G. Color:
   1. Fire Alarm System: Red

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Colors for Raceways Carrying Circuits at 600 V and Less:

1. **Black letters on an orange field**
2. Legend: Indicate voltage **and system or service type**.

C. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.
2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

C. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, and junction boxes each load connection.

D. Legend:
   1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
   2. Control Circuits: Control wire number indicated on shop drawings.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

2.5 FLOOR MARKING TAPE

A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.6 WARNING LABELS AND SIGNS


B. Metal-Backed, Butyrate Warning Signs:
   1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
   2. 1/4-inch grommets in corners for mounting.
   3. Nominal size, 10 by 14 inches.
   4. Nameplates used for warnings shall be red background with white lettering.

C. Warning label and sign shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
   2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
   1. Engraved legend with black letters on white face.
   2. Punched or drilled for mechanical fasteners.
   3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 EQUIPMENT IDENTIFICATION LABELS

A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a black background.
   1. Where identifying grouped equipment loads, Lettering should be a minimum of ¼” tall.
   2. Where identifying individual equipment and loads, Lettering should be a minimum of 1/8” tall.

B. Each receptacle and switch plate identifying source panel and circuit. Labels on receptacle and switch plates shall be directly engraved with ¼” text. Adhesive nameplates, stickers or slide in labels are not allowed.

2.9 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
   2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
   2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
   2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
   3. UL 94 Flame Rating: 94V-0.
   4. Temperature Range: Minus 50 to plus 284 deg F.
   5. Color: Black.
2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

I. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot maximum intervals.

B. Accessible Raceways and Cables within Buildings: All junction boxes containing emergency feeder or branch circuits shall be painted with the colors indicated below. All sides of the junction box shall be painted to allow easy identification including cover:
1. Orange: Critical Branch
2. Red Stripe: Life Safety Branch
3. Yellow: Equipment Branch.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

   a. Color shall be factory applied, heat shrinked (No cold applied permitted)
   b. Colors for 208/120-V Circuits:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral: White

D. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use write-on tags.

E. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

F. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.


   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Metal-backed, butyrate warning signs.

   2. Identify system voltage with black letters on an orange background.
   3. Apply to exterior of door, cover, or other access.
   4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
      a. Power transfer switches.
      b. Controls with external control power connections.
J. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
   a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, 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: Stenciled legend 4 inches high.
   c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:
   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
   b. Enclosures and electrical cabinets.
   c. Access doors and panels for concealed electrical items.
   d. Emergency system boxes and enclosures.
   e. Enclosed switches.
   f. Enclosed circuit breakers.
   g. Enclosed controllers.
   h. Variable-speed controllers.
   i. Push-button stations.
   j. Power transfer equipment.
   k. Contactors.
   l. Remote-controlled switches, dimmer modules, and control devices.
   m. Battery-inverter units.
   n. Monitoring and control equipment.

END OF SECTION 26 0553
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 a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

C. SCCR: Short-circuit current rating.

D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.
   1. Arc-flash study input data, including completed computer program input data sheets.
   2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.
      a. Submit initial study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
1.5 INFORMATIONAL SUBMITTALS
A. Qualification Data: For **Arc-Flash Study Specialist**.
B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data:
   1. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
   2. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE
A. Studies shall use SKM Power Tools Electrical Engineering Software computer program (PTW 32). Manual calculations or studies utilizing other software programs are not acceptable.
B. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE
   1. Do not use the "Use Equipment Specific Arc Flash Equation in Protective Device Library" method for arc flash calculations in the SKM software.
B. Comply with IEEE 1584 and NFPA 70E.
C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT
A. Executive summary.
B. Study descriptions, purpose, basis and scope.
C. One-line diagram, showing the following:
   1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output:
   a. Protective device designations and ampere ratings.
   b. Cable size and lengths.
   c. Transformer kilovolt amperes (kVA) and voltage ratings.
   d. Motor kVA ratings.
   e. Panelboard designations.
   f. Calculated X/R ratios and equipment interrupting rating (1/2 cycle) fault currents.
   g. Evaluate equipment and protective devices and compare to short-circuit ratings.

F. Arc-Flash Study Output:
   1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
      a. Voltage.
      b. Calculated symmetrical fault-current magnitude and angle.
      c. Fault-point X/R ratio.
      d. No AC Decrement (NACD) ratio.
      e. Equivalent impedance.
      f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
      g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

G. Incident Energy and Flash Protection Boundary Calculations:
   1. Arcing fault magnitude.
   2. Protective device clearing time.
   3. Duration of arc.
   5. Working distance.
   6. Incident energy.

H. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a waterproof, 3.5-by-5-inch self-adhesive, machine printed, equipment label for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
   1. Location designation and where fed from.
   2. Nominal voltage.
   3. Flash protection boundary.
5. Incident energy.
7. Proper level of PPE (Personal Protective Equipment)
8. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings. Submit sample of label for Owner Approval prior to installation. Contractor to install labels after sample approval.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance.

1. Submit preliminary arc flash hazard analysis with equipment submittals.
   a. The coordination and arc flash hazard analysis shall include but not be limited to:
      1) Service entrance equipment
         a) All overcurrent protective devices installed in service entrance panels.
      2) Feeder Circuits
         a) All three (3) phase Feeder circuit overcurrent protective devices installed with a rating equal to or greater than 30 amps.
      3) Branch Circuits.
         a) All three (3) phase branch circuit overcurrent protective devices installed with a rating equal to or greater than 30 amps.
         b) All motor circuit overcurrent protective devices for motors with a rating equal to or greater than 10 horsepower.

2. Revise arc flash hazard analysis after relevant equipment submittals have been approved and as installed feeder lengths verified. Overcurrent protective devices that have not been submitted and approved prior to study may not be used in study. Provide in both hardcopy and electronic disk format. The computer disk shall include the complete coordination file including all device curves (Use the SKM “Project-Backup” command).

3. Prior to project completion, the coordination study and arc flash hazard analysis shall be provided in both hard copy and on USB drive. The hard copy shall include time current curves (for phase and ground fault settings) for each panel and the corresponding TCC report clearly showing each device set point. The digital format shall include the complete coordination file including all device curves (Use the SKM “Project-Backup” command). **The digital format shall include the complete SKM data files for the project.**

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies:

1. Short-Circuit Study

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
1. **Identify any location other than the Service Entrance Main with a HCR>2 and provide recommendations for improvement.**

E. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.
1. Switchgear and switchboard bus.
   a. All overcurrent protective devices installed in service entrance panels.
2. Motor-control center.
   a. All motor circuit overcurrent protective devices for motors with a rating equal to or greater than 10 horsepower.
3. Distribution panelboard.
5. Three phase branch circuits with overcurrent protective devices installed with a rating equal to or greater than 30 amps.
6. Motor circuit overcurrent protective devices for motors with a rating equal to or greater than 10 horsepower.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
1. Fault contribution from induction motors should not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

J. Arc flash hazard analysis shall include the stamp or seal and signature of the preparing engineer, and shall be reviewed and approved by the Engineer of Record.

K. **Electronic models of all studies performed shall be turned over to the owner.**

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
1. Verify completeness of data supplied on the riser diagram on Drawings. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Obtain electrical power utility impedance at the service.

3. Power sources and ties.

4. Short-circuit current at each system bus, three phase and line-to-ground.

5. Full-load current of all loads.

6. Voltage level at each bus.

7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.

8. For reactors, provide manufacturer and model designation, voltage rating and impedance.

9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.

10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.

11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.

12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.

13. Motor horsepower and NEMA MG 1 code letter designation.

14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.4 LABELING

A. Apply one owner approved arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards, disconnects and transformers.

END OF SECTION 26 0574
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. Digital timer switches
   2. Indoor occupancy sensors.

B. Equipment Qualification
   1. Products supplied shall be from a single manufacturer that has been continuously involved in manufacturing or occupancy sensors for a minimum of five (5) years. Mixing of manufacturers shall not be allowed.
   2. Wall switch products must be capable of withstanding the effects of inrush current. Submittals shall clearly indicate the method used.

C. Related Requirements:
   1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

   1. Interconnection diagrams showing field-installed wiring.
   2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.
1.6 WARRANTY

A. Provide a five year complete manufacturer’s warranty on all products to be free of manufacturer’s defects.

PART 2 - PRODUCTS

2.1 DIGITAL TIME SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or Pre-approved comparable product. Submit a minimum of ten (10) working days prior to initial bid date for pre-approval. The listing of manufacturers below does not imply automatic approval. It is the sole responsibility of the contractor to ensure that any price quotations received and submittals made are for products that meet or exceed the basis of design as noted on drawings.

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Lightolier Controls; a Genlyte Company
5. Watt Stopper (The).
6. Hubbell

B. Digital time switch

1. The digital time switch shall be programmable to turn lights off after a preset time.
2. Time switch shall be a completely self-contained control system that replaces the standard toggle switch. It shall have a ground wire and ground strap for safety. Switching mechanism shall be a latching air gap relay.
3. Zero Crossing Circuitry shall be used to increase the relay life, protect from the effects of inrush current, and increase the switch’s longevity.
4. Time switch shall be compatible with all electronic ballasts, motor loads, ELV, MLV, LED and inductive loads. Triac and other harmonic generating devices shall not be allowed.
5. Time switch shall operate at universal voltages of 100-300 VAC; 50/60 Hz.
6. Time switch shall have no minimum load requirement and shall be capable of controlling 0 to 800 watt incandescent, fluorescent @ 100/120 VAC, 50/60 Hz.
7. Time scroll feature shall allow manual overriding of the preset time-out period. Selecting time scroll UP shall allow time-out period to scroll up throughout the timer possibilities to the maximum. Time scroll DN (down) shall allow time-out period to scroll down to minimum.
8. Time switch shall have the option for a one second light flash warning at five minutes before the timer runs out and twice when the countdown reaches one minute (when used to control lighting loads).
9. Time switch shall have the option for a beep warning that shall sound every five seconds once the time switch countdown reaches one minute.
10. Time switch shall have manual feature for timer reset where pressing the ON/OFF switch for more than 2 seconds resets the timer to the programmed time-out period.
11. Time switch shall have an electroluminescent backlit Liquid Crystal Display that shows the timer’s countdown.
12. Time switch shall fit behind a decorator style faceplate. The calibration switch for setting time-out, time scroll, one second light flash, and beep warning shall be concealed to prevent tampering of adjustments and hardware.
13. Time-out period shall be adjustable in increments of 5 minutes from 5 minutes to 1 hour, and in increments of 15 minutes from 1 hour to 12 hours.
14. Time switch shall be capable of operating as an ON/OFF switch.
15. For ease of installation and cleaner wiring, the switch shall utilize terminal style wiring.
16. The time switch shall not protrude more than 1/8" from the wall and should blend in aesthetically.
17. For safety, the time switch shall have a 100% OFF override switch with no leakage current to the load.
18. For safety, in the event there is an open circuit in the AC line such as a ballast or lamp failure, the time switch shall automatically switch to OFF mode.
19. To ensure quality and reliability, time switch shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
20. Time switch shall have 5 year warranty and shall be UL and CUL listed.

2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product as indicated on Drawings or or Pre-approved comparable product. Submit a minimum of ten (10) working days prior to initial bid date for pre-approval. The listing of manufacturers below does not imply automatic approval. It is the sole responsibility of the contractor to ensure that any price quotations received and submittals made are for products that meet or exceed the basis of design as noted on drawings.

1. Bryant Electric; a Hubbell company.
2. Cooper Industries, Inc.
3. Hubbell Building Automation, Inc.
5. Lightolier Controls.
6. Lithonia Lighting; Acuity Lighting Group, Inc.
7. Lutron Electronics Co., Inc.
8. Sensor Switch, Inc.
9. Square D; a brand of Schneider Electric.
10. Watt Stopper.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

C. Wall-Switch Sensor Tag ‘MS’:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft.
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type: SP.
4. Voltage: Dual voltage, 120 and 277 V; dual-technology type.
5. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
2.3 **CONDUCTORS AND CABLES**

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than **No. 18** AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than **No. 14** AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

**PART 3 - EXECUTION**

3.1 **SENSOR INSTALLATION**

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

C. When using wire for connections other than the DLM local network (Cat 5e with RJ-45 connectors), provide detailed point to point wiring diagrams for every termination. Provide wire specifications and wire colors to simplify contactor termination requirements.

D. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated.

3.2 **WIRING INSTALLATION**

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 3/4 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 **IDENTIFICATION**

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.4 PROGRAMMING
A. System switches shall be configured for manual-on (and auto-off) control of associated lighting unless otherwise noted.

3.5 FIELD QUALITY CONTROL
A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.
      a. Adjust time delay so that controlled area remains lighted for 5 minutes after occupant leaves area.

B. Re-commissioning – After 30 days from occupancy re-calibrate all sensor time delays and sensitivities to meet the Owner’s Project Requirements. Provide a detailed report to the Architect / Owner of re-commissioning activity.
C. Lighting control devices will be considered defective if they do not pass tests and inspections.
D. Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
   1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
   2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
   3. Load Parameters (e.g. blink warning, etc.)

3.6 DEMONSTRATION
A. Provide the proper training to Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 26 0923
SECTION 26 2416
PANELBOARDS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS
A. ATS: Acceptance testing specification.
B. GFCI: Ground-fault circuit interrupter.
C. GFEP: Ground-fault equipment protection.
D. MCCB: Molded-case circuit breaker.
E. SPD: Surge protective device.
F. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of panelboard.
   1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
   2. Include dimensions and manufacturers’ technical data on features, performance, electrical characteristics, ratings, and finishes.
B. Shop Drawings: For each panelboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details.
   2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
   3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
   4. Detail bus configuration, current, and voltage ratings.
   5. Short-circuit current rating of panelboards and overcurrent protective devices.
   6. Include evidence of NRTL listing for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.
B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Keys: Two spares for each type of panelboard cabinet lock.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
B. Handle and prepare panelboards for installation according to NECA 407.

1.10 FIELD CONDITIONS

A. Environmental Limitations:
1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   a. Ambient Temperature: Not exceeding \textbf{minus 22 deg F} to plus 104 deg F.
   b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
   1. Ambient temperatures within limits specified.
   2. Altitude not exceeding 6600 feet.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify \textbf{Owner} no fewer than \textbf{two} days in advance of proposed interruption of electric service.
   2. Do not proceed with interruption of electric service without \textbf{Owner's} written permission.
   3. Comply with NFPA 70E.

1.11 \textbf{WARRANTY}

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
   1. Panelboard Warranty Period: \textbf{24} months from date of Substantial Completion.

\textbf{PART 2 - PRODUCTS}

2.1 \textbf{PANELBOARDS COMMON REQUIREMENTS}

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: \textbf{Surface}-mounted, dead-front cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: NEMA 250, \textbf{Type 1}.
      b. Outdoor Locations: NEMA 250, \textbf{Type 3R}.
      c. Other Wet or Damp Indoor Locations: NEMA 250, \textbf{Type 4}, Stainless Steel.
d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Height: 84 inches maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Finishes:
   a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

F. Incoming Mains:
   1. Location: Convertible between top and bottom.
   2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

G. Phase, Neutral, and Ground Buses:
      a. Plating shall run entire length of bus.
      b. Bus shall be fully rated the entire length.
   2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
   3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
   4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
   5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
   6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.

H. Conductor Connectors: Suitable for use with conductor material and sizes.
   2. Terminations shall allow use of 75 deg C rated conductors without derating.
   3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
   4. Main and Neutral Lugs: Compression type, with a lug on the neutral bar for each pole in the panelboard.
   5. Ground Lugs and Bus-Configured Terminators: Two bolt Compression type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: **Compression** type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

7. Subfeed (Double) Lugs: **Compression** type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

8. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

I. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.

2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of panelboard, complying with UL 1449 SPD Type 2

2.3 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following:**

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. GE/ABB; General Electric by ABB.

3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than **36 inches** high, provide two latches, keyed alike.

D. Mains: **Circuit breaker** or **Lugs only** as indicated on drawings.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: **Bolt-on** circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.
2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. GE/ABB; General Electric by ABB.
   3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only as indicated in panelboard schedules.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with.tumbler lock; keyed alike.

F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. GE/ABB; General Electric by ABB.
   3. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers;
      a. Inverse time-current element for low-level overloads
      b. Instantaneous magnetic trip element for short circuits.
   2. Adjustable trip setting for circuit-breaker frame sizes 250 A and larger.
      a. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
         1) Instantaneous trip.
         2) Long- and short-time pickup levels.
         3) Long- and short-time time adjustments.
         4) Ground-fault pickup level, time delay, and I^2t response.
   3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
   4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
   5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
   7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
      a. Standard frame sizes, trip ratings, and number of poles.
      b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

f. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

g. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

h. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

i. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

j. Any device that can trip the breakers shall have a visible indication on the front of the panel.

C. SPD

1. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

2. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:

   a. Line to Neutral: 700 V.
   b. Line to Ground: 700 V.
   c. Neutral to Ground: 700 V.
   d. Line to Line: 1200 V.

3. SCCR: Equal to the SCCR of the panelboard in which installed.

4. Inominal Rating: 20 kA.

2.6 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.


   1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.7 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NECA 407.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NECA 407.

D. Equipment Mounting:
   1. Attach panelboard to the vertical finished or structural surface behind the panelboard.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Mount top of trim 90 inches above finished floor unless otherwise indicated.

G. Mount panelboard cabinet plumb and rigid without distortion of box.

H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

I. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.

J. Install overcurrent protective devices and controllers not already factory installed.
1. Set field-adjustable, circuit-breaker trip ranges.
2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

K. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

L. Install filler plates in unused spaces.

M. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

N. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Do not perform optional tests. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
   c. Instruments and Equipment:
      1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
   1. Measure loads during period of normal facility operations.
   2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
   3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
   4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 2416
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Straight-blade convenience receptacles, tamper-resistant receptacles, GFCI receptacles and associated device plates.
2. USB charger devices
3. Pendant cord-connector devices
4. Twist-locking receptacles.
5. Snap switches and wall-box dimmers.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.
B. GFCI: Ground-fault circuit interrupter.
C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
D. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
C. Field quality-control test reports.
D. Operation and Maintenance Data: For wiring devices to include in all manufacturers’ packing label warnings and instruction manuals that include labeling conditions.
1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers’ Names: Shortened versions (shown in parentheses) of the following manufacturers’ names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. All convenience receptacles to be of the quick connect type to have a right angle connector feature with pre-stripped leads. Connector contacts are to be crimped and welded.
2. Products: Basis of design: Pass & Seymour, PT5362 (duplex)
   a. Subject to compliance with requirements, provide one of the following:
      1) Cooper.Hubbell
      2) Leviton

B. Tamper-Resistant, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498, and FS W-C-596.

1. All convenience receptacles to be of the quick connect type to have a right angle connector feature with pre-stripped leads. Connector contacts are to be crimped and welded.
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; TR8300-M.
b. Pass & Seymour; (Tamper Resistant, Modular Wiring) 63H

c. Hubbell; (Tamper Resistant, Modular Wiring)-TR-HBL8300SG.

d. Leviton; (Tamper Resistant, Modular Wiring) TBR-20SGG.

3. Tamper-Resistant Convenience Receptacles are to be installed in the dwelling unit.

4. Provide all receptacles with quick disconnect plug in rear. Plug shall snap in at 90Deg angle.

2.3 USB CHARGER DEVICES

A. Tamper Resistant USB Charger with Duplex Receptacles, 2-Pole, 3-Wire Grounding, 20A, 125V, 5.1V DC 2.1A for charging capability. Transformer are not to be “on” until USB senses load: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; TR7746 (2 USB Charging Ports, 1 Nema 20A Duplex)

   b. Pass & Seymour; TR5361USB (2 USB Charging Ports, 1 Nema 20A Duplex)

2.4 GFCI RECEPTACLES

A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped. When ground fault protection is lost, power to the receptacle is disconnected.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. All convenience receptacles to be of the quick connect type to have a right angle connector feature with pre-stripped leads. Connector contacts are to be crimped and welded.

2. Products: Basis of design: Pass & Seymour, PT2095LA (duplex)

   a. Subject to compliance with requirements, provide one of the following:

      1) Cooper.

      2) Hubbell.

      3) Leviton.

2.5 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; L520R.

   b. Hubbell; HBL2310.

   c. Leviton; 2310.

   d. Pass & Seymour; L520-R.

2.6 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.
2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.7 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.

2.8 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

1. All Snap switches to be of the quick connect type to have a right angle connector feature with pre-stripped leads. Connector contacts are to be crimped and welded.

B. Switches, 120/277 V, 20 A:

1. Products: Basis of design: Pass & Seymour, PT20AC1 (single pole), PT20AC2 (two pole), PT20AC3 (three way), PT20AC4 (four way).
   a. Subject to compliance with requirements, provide one of the following:
      1) Cooper
      2) Hubbell.
      3) Leviton.

C. Pilot Light Switches, 20 A:

1. Products: Basis of design: Pass & Seymour, PT20AC1-SL (single pole), PT20AC3-SL (three way), PT20AC4 (four way).
   a. Subject to compliance with requirements, provide one of the following:
      1) Cooper
      2) Hubbell.
      3) Leviton.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

2.9 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
C. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.10 WALL PLATES

A. Single and combination types to match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: Smooth, high-impact thermoplastic
   4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.11 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.
   1. Wiring Devices Connected to Normal Power System: White or As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:
   1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
   2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
   3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
   4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
   1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
   2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
   3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:
1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtailed that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtailed for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:
1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers’ device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section “Identification for Electrical Systems.”
1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with **black**-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### 3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Test straight blade *convenience outlets in patient-care areas, hospital-grade convenience outlets* for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz.

1. Refer to NFPA 99 Section 6.3.2 for Testing Requirements:
   a. Visual Inspection
   b. Grounding Continuity
   c. Correct Polarity
   d. Retention force

**END OF SECTION 26 2726**
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. Cartridge fuses rated 600-V ac and less for use in enclosed switches.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
   a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
   b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.


4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.

5. Coordination charts and tables and related data.

6. Fuse sizes for elevator feeders and elevator disconnect switches.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.

2. Current-limitation curves for fuses with current-limiting characteristics.

3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format to be used with SKM software.

4. Coordination charts and tables and related data.
1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

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

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:
   1. Motor Branch Circuits: Class RK1, time delay.
   2. Other Branch Circuits: Class RK1, time delay.
   3. Control Circuits: Class CC, fast acting.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 2813
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. Fusible switches.
2. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.
B. NO: Normally open.
C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit in electronic format to be used with SKM software.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Field quality-control reports.
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Manufacturer's field service report.

E. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
   2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit in electronic format to be used with SKM software.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg.
   2. Altitude: Not exceeding 6600 feet.
B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner per requirements in the front end documents.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Compression type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.
8. Accessory Control Power Voltage: Remote mounted and powered; **120-V ac.**

**PART 3 - EXECUTION**

### 3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

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

### 3.2 INSTALLATION

A. 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 Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

### 3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. **Test and adjust controls, remote monitoring, and safeties.** Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 **ADJUSTING**

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

END OF SECTION 26 2816
SECTION 26 5119
LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes LED luminaires:

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project. IES LM-79 and IES LM-80.

a. Manufacturers’ Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
B. Shop Drawings: For nonstandard or custom luminaires.
   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. **Use same designations indicated on Drawings.**

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing laboratory providing photometric data for luminaires.

B. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Product Certificates: For each type of luminaire.

D. Product Test Reports: For each luminaire, for tests performed by **manufacturer and witnessed by a qualified testing agency.**

E. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
   1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. **Diffusers and Lenses:** **One for every 100** of each type and rating installed. Furnish at least one of each type.
   2. **Globes and Guards:** **One for every 20** of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Standards:
   1. UL Listing: Listed for damp location.
   2. Recessed luminaires shall comply with NEMA LE 4.
   3. User Replaceable Lamps:
      a. Bulb shape complying with ANSI C78.79.
      b. Lamp base complying with ANSI C81.61 or IEC 60061-1].

C. CRI of minimum 90. CCT of 3500 K. (Unless specifically noted otherwise on drawings)

D. Rated lamp life of 50,000 hours to L70.

E. Lamps dimmable from 100 percent to 0 percent of maximum light output.

F. Internal driver.
   1. Provide remote driver for fixtures in Large RR, Traditional Performance Space, Isolation Rooms and Live Room/Jazz Combo Rehearsal as noted on the drawings.

G. Nominal Operating Voltage: 120 V ac or as noted on the drawings.
   1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

H. Housings:
   1. Extruded-aluminum housing and heat sink.
   2. powder-coat painted finish or as noted in Luminaire Schedule.

2.2 LUMINAIRE TYPES

A. Refer to Luminaire Schedule on the Drawings for each Luminaire Type.
1. Contractor may submit substitution request for equal products to those listed in the Luminaire schedule prior to bid for evaluation. If approved, formal approval will be issued. No substitutions will be entertained and/or permitted after bid date.

2.3 MATERIALS

A. Metal Parts:
   1. Free of burrs and sharp corners and edges.
   2. Sheet metal components shall be steel unless otherwise indicated.
   3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:
   1. prismatic acrylic
   2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label shall include the following lamp characteristics:
      a. "USE ONLY" and include specific lamp type.
      b. Lamp diameter, shape, size, wattage, and coating.
      c. CCT and CRI for all luminaires.

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.


D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   3. Provide support for luminaire without causing deflection of ceiling or wall.
   4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:
   1. Secured to outlet box.
   2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
   3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:
   1. Attached to a minimum 20 gauge backing plate attached to wall structural members.
   2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Mounted Luminaire Support:
   1. Ceiling mount with two 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.

H. Suspended Luminaire Support:
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.

4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 26 5119
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. Emergency lighting units.
   2. Luminaire supports.

1.3 DEFINITIONS
A. CCT: Correlated color temperature.
B. CRI: Color Rendering Index.
C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.
D. Fixture: See "Luminaire" Paragraph.
E. Lumen: Measured output of lamp and luminaire, or both.
F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
   1. Include data on features, accessories, and finishes.
   2. Include physical description of the unit and dimensions.
   3. Battery and charger for light units.
   4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
   5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.
      a. Manufacturers’ Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
B. Shop Drawings: For nonstandard or custom luminaires.
   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

C. Product Schedule:
   1. For emergency lighting units. Use same designations indicated on Drawings.
   2. For exit signs. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For testing laboratory providing photometric data for luminaires.
   B. Product Certificates: For each type of luminaire.
   C. Product Test Reports: For each luminaire for tests performed by manufacturer and witnessed by a qualified testing agency.
   D. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.
      1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 QUALITY ASSURANCE
   A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

1.8 DELIVERY, STORAGE, AND HANDLING
   A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY
   A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
      1. Warranty Period: Five year(s) from date of Substantial Completion.
B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Power Unit Batteries: Five years from date of Substantial Completion. Full warranty shall apply for **first year and prorated warranty for the remaining four years**.
2. Warranty Period for Self-Powered Exit Sign Batteries: Five years from date of Substantial Completion. Full warranty shall apply for **the entire warranty period**.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified."

#### 2.2 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Comply with UL 1598 for fluorescent luminaires.

F. Lamp Base: Comply with ANSI C81.61 or IEC 60061-1.

G. Bulb Shape: Complying with ANSI C79.1.

#### 2.3 EMERGENCY LIGHTING

A. Refer to Luminaire Schedule on the Drawings for each Luminaire Type.

1. **Contractor may submit substitution request for equal products to those listed in the Luminaire schedule prior to bid for evaluation. If approved, formal approval will be issued. No substitutions will be entertained and/or permitted after bid date.**

B. General Requirements for Emergency Lighting Units: Self-contained units.

C. Emergency Lighting Unit:
1. Wall with universal junction box adaptor.
2. UV stable thermoplastic housing, rated for damp locations.
3. Two LED lamp heads.
4. Internal emergency power unit.
5. Self-Diagnostics

D. Remote Emergency Lighting Units:
   1. Wall with universal junction box adaptor.
   2. UV stable thermoplastic housing, rated for damp locations.
   3. Two LED lamp heads.
   4. External emergency power unit.

2.4 MATERIALS

A. Metal Parts:
   1. Free of burrs and sharp corners and edges.
   2. Sheet metal components shall be steel unless otherwise indicated.
   3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:
   1. Smooth operating, free of light leakage under operating conditions.
   2. Designed to permit relamping without use of tools.
   3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:
   1. Clear, UV-stabilized acrylic.
   2. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Conduit: Electrical metallic tubing, minimum 3/4 inch in diameter.

2.5 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

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

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire and emergency power unit weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:

1. Attached to a minimum 20-gage backing plate attached to wall structural members.
2. Do not attach luminaires directly to gypsum board.

F. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling Grid Mounted Luminaires:
1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service:

1. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

END OF SECTION 26 5219
SECTION 27 0500
COMMON WORK RESULTS FOR COMMUNICATIONS

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. Communications equipment coordination and installation.
2. Common communications installation requirements.

1.3 COORDINATION
A. Coordinate arrangement, mounting, and support of communications equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
E. Coordinate sleeve selection and application and installation as specified in Division 27 Section "Sleeves and Sleeve Seals for Communications Pathways and Cabling."
PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves as specified in Division 27 Section “Sleeves and Sleeve Seals for Communications Pathways and Cabling.”

3.3 SLEEVE-SEAL INSTALLATION

A. Install sleeve-seals as specified in Division 27 Section “Sleeves and Sleeve Seals for Communications Pathways and Cabling.”

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section “Penetration Firestopping.”

END OF SECTION 27 0500
SECTION 270544
SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
   2. Grout.

B. Related Requirements:
   1. Division 07 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:
   2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
   1. Use EZ-PATH Smoke and Acoustical Pathways as noted on drawings (or pre-approved equal).

C. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
D. Sleeves for Rectangular Openings:
   2. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
      b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.


C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section  “Joint Sealants.”
      b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
  1. Use the EZ-Path smoke and acoustical pathways. (Or pre-approved equal)

3.2 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 27 0544
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Fire-alarm control unit.
   3. System smoke detectors.
   5. Addressable interface device.
   6. Digital alarm communicator transmitter.
   7. Network communications.

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.
B. FACP: Fire Alarm Control Panel.
C. NICET: National Institute for Certification in Engineering Technologies.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.
   1. Include construction details, material descriptions, dimensions, profiles, and finishes.
   2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.
   1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   2. Include plans, elevations, sections, details, and attachments to other work.
   3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
   4. Detail assembly and support requirements.
5. Provide design calculations showing current draw on each notification circuits with allowance for minimum **20% expansion**.

6. Include voltage drop calculations for notification-appliance circuits.

7. Include battery-size calculations and show that they are sized a minimum of **125%** of calculated requirement.

8. Include input/output matrix.

9. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.

10. Include performance parameters and installation details for each detector.

11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

12. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.

13. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.

   a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
   b. Show field wiring required for HVAC unit shutdown on alarm.
   c. Locate detectors according to manufacturer's written recommendations.
   d. Show air-sampling detector pipe routing.

14. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.

2. Shop Drawings shall be prepared by persons with the following qualifications:

   a. Trained and certified by manufacturer in fire-alarm system design.
   b. NICET-certified, fire-alarm technician; **Level IV** minimum.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

1.6 Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

   1. In addition to items specified in Section 017823 “Operation and Maintenance Data,” include the following:
a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Record copy of site-specific software.
g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.
2) Frequency of testing of installed components.
3) Frequency of inspection of installed components.
4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

h. Manufacturer's required maintenance related to system warranty requirements.
i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

B. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Siemens Building Automatic systems. Cerberus PRO (Basis of Design)
2. Fire Control Instruments, Inc.; a Honeywell company.
3. NOTIFIER; a Honeywell company.
2.2 SYSTEM DESCRIPTION

A. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.

B. Automatic sensitivity control of certain smoke detectors.

C. All components provided shall be listed for use with the selected system.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
   2. Smoke detectors.
   3. Duct smoke detectors.
   4. Carbon monoxide detectors.
   5. Automatic sprinkler system water flow.

B. Fire-alarm signal shall initiate the following actions:
   1. Continuously operate alarm notification appliances.
   2. Identify alarm and specific initiating device at fire-alarm control unit.
   3. Transmit an alarm signal to the remote alarm receiving station.
   4. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
   5. Record events in the system memory.
   6. Downloads, prints system-event history & detector sensitivity
   7. Supervised remote printer

C. Supervisory signal initiation shall be by one or more of the following devices and actions:
   1. Valve supervisory switch.
   2. Independent fire-detection and -suppression systems.
   3. User disabling of zones or individual devices.

D. System trouble signal initiation shall be by one or more of the following devices and actions:
   1. Open circuits, shorts, and grounds in designated circuits.
   2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
   3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
   4. Loss of primary power at fire-alarm control unit.
   5. Ground or a single break in internal circuits of fire-alarm control unit.
   6. Abnormal ac voltage at fire-alarm control unit.
   7. Break in standby battery circuitry.
   8. Failure of battery charging.
   9. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Supervisory Signal Actions:
1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit.
3. Record the event on system printer.
4. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.

2.4 PERFORMANCE REQUIREMENTS

2.5 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
   a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
   b. Include a real-time clock for time annotation of events on the event recorder and printer.
   c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
   d. The FACP shall be listed for connection to a central-station signaling system service.
   e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.

3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, two line(s) of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B.
2. Pathway Survivability: Level 0.
3. Install no more than 50 addressable devices on each signaling-line circuit.
4. Serial Interfaces:
   a. One dedicated RS 485 port for central-station operation using point ID DACT.
b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
c. One USB port for PC configuration.

D. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

E. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

F. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

G. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

H. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.


K. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate
response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.6 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
   1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
   2. Station Reset: Key- or wrench-operated switch.

2.7 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:
   1. Comply with UL 268; operating at 24-V dc, nominal.
   2. Detectors shall be two-wire type.
   3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
   4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
   5. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
   6. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
      a. Multiple levels of detection sensitivity for each sensor.
      b. Sensitivity levels based on time of day.
   7. Detectors in bedrooms and corridors shall have an integral sounder base. Piezoelectric sounder rated at 90dBA at 10 feet according to UL 464.

B. Photoelectric Smoke Detectors:
   1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
   2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
      a. Primary status.
      b. Device type.
      c. Present average value.
      d. Present sensitivity selected.
      e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
   1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.

4. Each sensor shall have multiple levels of detection sensitivity.

5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.


2.8 CARBON MONOXIDE DETECTORS

A. General: Carbon monoxide detector listed for connection to fire-alarm system.

   1. Mounting: Adapter plate for outlet box mounting.
   2. Testable by introducing test carbon monoxide into the sensing cell.
   3. Detector shall provide alarm contacts and trouble contacts.
   4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
   5. Comply with UL 2075.
   6. Locate, mount, and wire according to manufacturer's written instructions.
   7. Provide means for addressable connection to fire-alarm system.
   8. Test button simulates an alarm condition.

2.9 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.

   1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.

   1. Rated Light Output:
      a. 15/30/75/110 cd, selectable in the field.
   2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.

D. Exit Marking Audible Notification Appliance:
   1. Exit marking audible notification appliances shall meet the audibility requirements in NFPA 72.
   2. Provide exit marking audible notification appliances at the entrance to all building exits.

2.10 ADDRESSABLE INTERFACE DEVICE

A. General:
   1. Include address-setting means on the module.
   2. Store an internal identifying code for control panel use to identify the module type.
   3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Control Module:
   1. Operate notification devices.
   2. Operate solenoids for use in sprinkler service.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:
   1. Verification that both telephone lines are available.
   2. Programming device.
   3. LED display.
   5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:
1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.12 NETWORK COMMUNICATIONS

A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.

B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

2.13 SYSTEM PRINTER

A. Printer shall be listed and labeled as an integral part of fire-alarm system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

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

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

C. Manual Fire-Alarm Boxes:
   1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
   3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:
   1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
   2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
   3. Smooth ceiling spacing shall not exceed 30 feet.
   4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A in NFPA 72.
   5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
   6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.
   1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

H. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

J. Device Location-Indicating Lights: Locate in public space near the device they monitor.
3.3 PATHWAYS

A. Pathways shall be installed in EMT.

B. Exposed EMT shall be painted red enamel.

3.4 CONNECTIONS

A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   1. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
   2. Supervisory connections at valve supervisory switches.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Perform tests and inspections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Visual Inspection: Conduct visual inspection prior to testing.
      a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
      b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

3. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 28 3111
SECTION 31 1000
SITE CLEARING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, include General and Supplementary
Conditions, apply to this Section.

B. Storm Water Pollution Prevention Plan (SWPPP) dated November 2, 2018 and prepared by
Crockett Engineering Consultants.

1.2 SUMMARY

A. Section includes:
   a. Protecting existing vegetation to remain.
   b. Removing existing vegetation.
   c. Clearing and grubbing.
   d. Stripping and stockpiling topsoil.
   e. Removing above and below grade site improvements shown to be removed.
   f. Disconnecting, capping or sealing, and removing site utilities.
   g. Temporary erosion and sedimentation control.

B. Related Requirements:
   a. Current City of Columbia Land Disturbance Permit requirements.
   b. Current Missouri Department of Natural Resources Land Disturbance Permit
      requirements.

1.3 DEFINITIONS

A. BMPs: The term Best Management Practices is used to describe the controls and activities
used to prevent stormwater pollution.

B. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally
occurring soil profile, typified by less than one percent organic matter and few soil
organisms.

C. Topsoil: Top layer of the soil profile usually richest in organic matter and nutrients
consisting of existing native surface topsoil or existing in-place surface soil; the zone where
plant roots grow. Its appearance is generally friable, pervious, and black or darker shade of
brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay, lumps, gravel,
and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials,
or other nonsoil materials. A pH range of 5.0-7.5 is acceptable.
D. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.

E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain on Owner's property, manmade cleared materials shall become Contractor's property and shall be removed from the project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:
   1. Erosion control blankets / turf reinforcement mats.
   2. Sediment fencing.

1.6 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
   a. Use sufficiently detailed photographs or video recordings.
   b. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designed to remain.

B. Record Drawings: Identify and accurately showing location of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.7 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied of used facilities during site clearing operations.
   1. Do not close or obstruct streets, walks or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
   1. Do not proceed with work on adjoining property until directed by the Owner.

C. Utility Locator Service: Notify "Missouri One Call" for area where project is located and obtain and verify all existing utility locations before starting project.

D. Do not commence site clearing operations until temporary erosion and sediment control and tree protection measures are in place.

E. Tree-Protection Zones: Protect according to requirements in project plans.
F. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 31 2000 “Earth Moving.”

PART 3 – EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction. The owner will provide three survey control points for Contractor use.
B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in the project plans.
C. Protect existing site improvements to remain from damage during construction.
   a. Restore damaged improvements to their original condition, as acceptable to the Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sediment control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion and sediment control drawings and requirements of the authorities having jurisdiction.
B. Verify that flows of water redirected from construction areas or generated by construction activities do not enter or cross protection zones.
C. Inspect, maintain, and repair erosion control and sediment control measures during construction until permanent vegetation has been established.
D. Remove erosion and sediment controls, and restore and stabilize areas disturbed during removal.
E. Completely fill out all aspects of SWPPP prior to any site disturbing activities.
F. Adhere to all aspects of erosion and sediment control as indicated in the project SWPPP, Plans, and any required site disturbance permits.
G. Obtain any and all required permits prior to any site disturbing activities.

3.3 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site according to requirements in project plans.
B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations.

3.4 EXISTING UTILITIES

A. Arrange for disconnecting and sealing utilities that serve existing structures before site clearing.
   a. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Interrupting Existing Utilities: Do not interrupt utilities serving offsite facilities.

C. Excavate for and remove underground utilities indicated to be removed.

D. Removal of underground utilities is included in earthwork sections.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
   a. Do not remove trees, shrubs, and other vegetation indicated to remain or to be protected.
   b. Excavate to remove the entire root ball for woody vegetation.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
   a. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.
   b. Finish grade all areas to provide positive drainage.

C. Burning: Do not burn!

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to a depth of 6 inches or as encountered in the field in a manner to prevent intermingling with underlying subsoil or other waste materials.
   a. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to protect windblown dust and erosion by water.
   a. Limit height of topsoil stockpile to 72 inches.
   b. Do not stockpile topsoil within protection zones.
   c. Adhere to all current City of Columbia stockpile requirements.
3.7 SITE IMPROVEMENTS

A. Remove existing above and below ground improvements as indicated to facilitate new construction.

B. Remove all slabs, paving, curbs, gutters, foundations, and aggregate bases shown to be removed.

C. Remove all utilities, both underground and above ground, shown to be removed on the civil drawings.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove all demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner’s property.

END OF SECTION 31 1000
SECTION 31 2000
EARTH MOVING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:
   a. Excavating and filling for rough grading the Site.
   b. Preparing subgrades for slab-on-grade, walks, pavements, turf and grasses, and plants.
   c. Excavating and backfilling for buildings and structures.
   d. Drainage course for concrete slabs-on-grade.
   e. Subbase course for concrete walks, and pavements.
   f. Subbase course and base course for asphalt paving.
   g. Subsurface drainage backfill for walls and trenches.
   h. Excavation and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:
   a. Section 311000 “Site Clearing” for site stripping, grubbing, stripping, and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
   b. Section 329200 “Turf and Grasses” for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill excavation.
   1. Initial Backfill: Backfill places beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Course: Satisfactory soil imported from off – site use as fill or backfill.
E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to line and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Owner. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
   2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Owner. Unauthorized excavation, as well as remedial work directed by Owner, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material ¾ cu. Yard (0.57 cu. m) or more in volume.

I. Structures; Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above to below the ground surface.

J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement or aggregate layer placed between the subgrade and a cement concrete pavement or hot-mix asphalt walk.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or back fill immediately below subbase, drainage fill, drainage course, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 SUBMITTALS

A. Product Data: For each type of the following manufactured products required:
   1. Warning tapes.
   2. Vapor Barrier.

B. Samples for Verification: For the following products, in sizes indicated below:
   1. Warning Tape: 12 inches (300 mm) long; of each color.
   2. Vapor Barrier: 12 inches by 12 inches.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: for qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material for proposed fill and backfill as follows:
   a. Classification according to ASTM D 2487
   b. Laboratory compaction curve according to ASTM D 698.
C. Pre-excavation photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surface that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.6 FIELD CONDITIONS

A. Traffic; Minimize interference with adjoining roads, streets, walks, and other adjacent occupied of used facilities during earth-moving operations.
   1. Do not close or obstruct streets, walks or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner’s property will be obtained by Owner before award of Contract.
   1. Do not proceed with work on adjoining property until directed by the Owner.

C. Utility locator Service: Notify “Missouri One Call” for area where Project is located before beginning earth-moving operations.

D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation- control measures indicated in civil plans are in place.

E. Do not commence earth-moving operations until tree protection measures indicated in civil plans are in place.

1.7 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from extensions.

B. Satisfactory Soils: Soils Classification Groups GW, GM, GC, SW, SP, SM, SC and CL according to ASTM D 2487 or a combination of these groups; free of rock or gravel larger than 8 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Soils that classify as CH should be analyzed and approved by a qualified geotechnical engineer prior to use.

C. Unsatisfactory Soils: Soil Classification Groups OL, MH, OH, and PT according to ASRM D 2487 or a combination of these groups.
   a. Unsatisfactory soils also include satisfactory soils not maintained within -2 to +4 percent of optimum moisture content at time of compaction.

D. Subbase Material: Subbase material shall meet the crushed stone base MoDOT requirements of Section 1007 of the current Missouri Standards for Highway Construction, Type 1.
E. Engineered Fill: Controlled and compacted soil fill placed in accordance with ASTM D698.

F. Bedding Course: Per ASTM C33 #67 or approved equal.

G. Drainage Course: Rock course meeting the graduation requirements for a #67 rock as defined by ASTM C 33.

1.8 ACCESSORIES

A. Detectable warning tape: Acid and Alkali resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with the description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried 30 inches deep; colored as follows
   a. Red: Electric
   b. Yellow: Gas, Oil, steam, and dangerous materials
   c. Orange: Telephone and other communications
   d. Blue: Water systems
   e. Green: Sewer systems

PART 2 – EXECUTION

2.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

2.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding project site and surrounding areas.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
   a. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavation. Do not sure excavated trenches as temporary drainage ditches.

2.3 EXPLOSIVES
A. Do not use explosives.

2.4 EXCAVATION, GENERAL

A. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross-sectioned by the Design Team. The contract sum will be adjusted for rock excavation according to unit prices included in the contract documents. Changes in the contract time may be authorized for rock excavation.
   a. Earth excavation includes excavating pavements and obstructions visible on the surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders and other materials not classified as rock or unauthorized excavation.
      i. Intermittent drilling, ram hammering, or ripping of material not classified as rock excavation is earth excavation.

B. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the dimensions indicated in the unit prices.

2.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus one inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   a. Excavations for footings and foundations; Do not disturb bottom excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
   b. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

2.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surface under walks and pavements to indicated lines, cross sections, elevations, and subgrades

2.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.
   a. Beyond the building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipes or conduits. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise noted.
   a. Clearance: 6 inches on each side of pipe or conduit, or as indicated on the drawings.
C. Trench bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduits. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
   a. Excavate trenches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

2.8 SUBGRADE INSPECTION

A. Notify Owner when excavations have reached required subgrade.

B. If Owner determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrade.
   a. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
   b. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner, and replace with compacted backfill or fill as direct.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Owner, without additional compensation.

2.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by the Owner.
   a. Fill unauthorized excavations under other construction, pipe, or conduit as directed by the Owner.

2.10 UNAUTHORIZED EXCAVATION

A. Stockpile borrow soil materials and excavated satisfactory soil material without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   a. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

2.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:
   a. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
b. Surveying locations of underground utilities for Record Documents.
c. Testing and inspecting underground utilities.
d. Removing concrete formwork.
e. Removing trash and debris.
f. Removing temporary shoring, bracing, and sheeting.
g. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow or ice.

2.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of much, frost, snow or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings with lean concrete fill, with 28-day compressive strength of 2500 psi.

D. Trenches under Roadways: Place and compact backfill for Engineered Fill material to bottom of the roadway pavement and a minimum of 1 foot beyond edge of pavement in all directions. Place and compact in 8 inch maximum lifts.

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Place and compact initial backfill of Engineered Fill, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
   a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

G. Final Backfill (if not specifically indicated in civil plans):
   a. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

H. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

2.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical unit to 5 horizontal units so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
   a. Under grass and planted areas, use satisfactory soil material.
   b. Under walks and pavements, use satisfactory soil material.
   c. Under steps and ramps, use satisfactory soil material.
   d. Under building slabs, use satisfactory soil material.
   e. Under footings and foundations, use satisfactory soil material.
f. Under grass and planted areas, use satisfactory soil material to achieve grades to bottom of topsoil layer. Achieve finished grade by placing a topsoil layer to thickness indicated in the civil plans.
   i. Topsoil shall be obtained from the on-site topsoil pile created with the initial grading operations.
g. Place soil fill on subgrade free of mud, frost, snow, or ice.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

2.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within -2% to +4% of optimum moisture content.
   a. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
   b. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by +4 percent and is too wet to compact to specified dry unit weight.

2.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers

B. Place backfill and fill soil materials on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
   a. Under building slabs, compact each layer of backfill or fill soil material at least 95 percent.
   b. Under walkways, structures, steps, and pavements, compact each layer of backfill or fill soil material at least 95 percent.
   c. Under turf or unpaved areas, compact each layer of backfill or fill soil material at least 95 percent to achieve bottom of topsoil layer elevation. Topsoil surface material shall not exceed 80-85 percent compaction. Light compaction only. Do not allow vehicular access within topsoil areas after placement. Excessively hardened, compacted, or tight topsoil will be rejected and is to be replaced by the Contractor at no cost to the Owner.
   d. For utility trenches, compact each layer of initial and final backfill soil material at least 95 percent.

2.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   a. Provide a smooth transition between adjacent existing grades and new grades.
   b. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevation, within the following subgrade tolerances:
   a. Turf or Unpaved Areas: Plus or minus 1 inch.
   b. Athletic Field Areas: Plus or minus 1/4 inch.
   c. Walks: Plus or minus 1/2 inch.
   d. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of ½ inch when tested with a 10-foot straightedge.

D. Within Athletic Fields:
   a. Final subgrade preparation receiving topsoil shall be done with equipment that does not leave indentations deeper than 1/2 inch. Typical wheeled road grading equipment is prohibited. Equipment with flotation turf tires, or lightweight designs specific for turf preparation/maintenance are acceptable.

2.17 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place on subbase course on subgrades free of mud, frost, snow or ice.

B. On prepared subgrade, place subbase course under pavements and walks as follows:
   a. Shape subbase course to required crown elevations and cross-slope grades.
   b. Place subbase course 6 inches or less in compacted thickness in a single layer.
   c. Place subbase course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
   d. Compact subbase course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

2.18 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
   a. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
   b. Place drainage course 6 inches or less in compacted thickness in a single layer.
   c. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
   d. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

2.19 FIELD QUALITY CONTROL
A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work will comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by the Design Team.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:
   a. Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2,500 square feet or less of paved area or building pad, but in no case fewer than three tests.
   b. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 150 feet or less of wall length, but no fewer than two tests.
   c. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length but no fewer than two tests.
   d. Paved areas, sidewalks, Athletic fields, and other potential structural areas: At each compacted backfill layer, at least one test for every 10,000 square feet, but in no case fewer than three tests per lift.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

2.20 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
   a. Scarify or remove and replace soil material to depth as directed by the Owner; reshape and recompact.

C. Where settling occurs before project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
   a. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

2.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove waste material, trash, and debris, and legally dispose of them off the Owner’s property.

END OF SECTION 31 2000
SECTION 31 2500 – EROSION CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Installation of temporary water pollution control measures to prevent discharge of pollutants such as chemicals, fuels, lubricants, bitumen, raw sewage, or other harmful material from the project.

B. Drawings and General Provisions of Contract, including General and Special Conditions, apply to this section.

1.2 GENERAL

A. The Contractor shall manage his operations to control water pollution in accordance with this specification and applicable State regulations. Construction of permanent drainage facilities and other contract work, contributing to control of erosion, shall be scheduled at the earliest practicable time.

B. The Contractor shall furnish, install, maintain and remove temporary erosion control measures. The Contractor shall prevent discharging silt or polluted storm water from the site.

C. The Owner’s Representative may require installation of additional erosion control facilities, by the Contractor, if in the sole opinion of the Owner’s Representative the Contractor’s efforts are adequate.

1.3 DEFINITIONS

A. Temporary Berm: A temporary ridge of compacted soil, with or without a shallow ditch, constructed at the top of slopes or transverse to the centerline of a slope. The berm diverts storm runoff to temporary outlets to discharge water with minimal erosion.

B. Temporary Seeding and Mulching: Placement of a quick ground cover to reduce erosion in areas expected to be re-disturbed.

C. Straw Bales: Standard agricultural bales used to filter the flow of water trap, deposit sediment, and/or divert water.

D. Silt Fence: A geotextile barrier fence to contain sediment by removing suspended particles from water passing through the fence.

E. Sediment Removal: Removal of accumulated sediment to restore the efficiency of sediment control features.

1.4 SUBMITTALS

A. The Contractor shall submit any coordinate any field modifications to the “Erosion Control Plan” for review and approval by the Owner’s Representative. Approval of the plan changes does not relieve the Contractor of his contractual responsibility to prevent the discharge of pollutants into the receiving drainage ways.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Temporary Seeding:
1. December 1 to March 1: 50 lbs. oats/acre
2. March 1 to December 1: 50 lbs. cereal rye or wheat

B. Mulch shall be wheat straw.

C. Wire Supported and Self Supporting Silt Fence:
1. Geotextile Fabric
   a. Fibers used in geotextiles shall consist of longchain synthetic polymers, composed of at least 85 percent by weight polyolefins, polyesters, or polyamides. They shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including selvages.
   b. The geotextile shall be free of any treatment or coating which might adversely alter its physical properties after installation.
   c. Geotextile shall be furnished in 36” width rolls.
   d. Geotextile rolls shall be furnished with suitable wrapping for protection against moisture and extended ultraviolet exposure.
   e. Each roll shall be labeled or tagged to provide product identification sufficient for inventory.
   f. Rolls shall be stored in a manner, which protects them from the elements.
   g. Geotextile shall conform to the following:

   TABLE 1
   PHYSICAL REQUIREMENTS FOR TEMPORARY SILT FENCE GEOTEXTILES

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Wire Fence Supported Requirements</th>
<th>Self Supported Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength, Lbs.</td>
<td>ASTM D4632</td>
<td>90 Minimum</td>
<td>90 Minimum</td>
</tr>
<tr>
<td>Elongation at 50% Minimum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile Strength (45 Lbs.)</td>
<td>ASTM D4632</td>
<td>N/A</td>
<td>50 Maximum</td>
</tr>
<tr>
<td>Filtering Efficiency, %</td>
<td>VTM-51</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>Flow Rate gal/ft/min</td>
<td>VTM-51</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Ultraviolet Degradation at 500 hrs.</td>
<td>ASTM D4355</td>
<td>Minimum 70% Strength Retained</td>
<td>Minimum 70% Strength Retained</td>
</tr>
</tbody>
</table>

1. Notes: All numerical values represent minimum average roll value. When tested in any principal direction. Virginia DOT test method.

2. Posts: Wood, steel, or synthetic post may be used. Posts shall have a minimum length of 36” plus embedment depth (24” min.). Posts shall have sufficient strength to resist damage during installation and to support applied loads.

3. Support Fence: Wire or other support fence shall be at least 24” high and strong enough to support applied loads.

4. Prefabricated Fence: Prefabricated fence systems may be used provided they meet all of the above material requirements.
2.2 CLEANOUTS

A. The Contractor shall furnish a manufacturer's certification, stating the material conforms to the requirements of these specifications.

B. The certification shall include, or have attached, typical results of tests for the specified properties, representative of the materials supplied.

C. The Owner’s Representative reserves the right to sample and test any material offered for use.

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

A. The Owner’s Representative may limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow, or fill operations.

B. The Owner’s Representative may direct the Contractor to provide immediate permanent or temporary pollution control measures to prevent contamination of adjacent streams, other watercourses, lake, ponds, or other areas of water impoundment. Work may involve the construction of temporary berms, dikes, dams, sediment basins, slope drains, use of temporary mulches, seeding or other control devices or methods to control erosion.

C. The Contractor shall incorporate permanent erosion control feature at the earliest practicable time.

D. The Contractor at no additional cost shall provide temporary pollution control measures needed to control erosion during normal construction practices to the Owner.

3.2 LIMITATION OF AREA DISTURBED

A. The Owner’s Representative may limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow, or fill operations. The Contractor’s operations shall be scheduled to install erosion control features immediately after clearing and grubbing.

B. The Owner’s Representative may limit the area of clearing and grubbing, excavation, borrow, and embankment operations commensurate with the Contractor’s capability and progress in completing the finish grading, mulching, and seeding.

C. The Contractor shall respond to seasonal variations. If required by weather, temporary erosion control measures shall be taken immediately.

3.3 BORROW AND WASTE AREAS

A. Material pits other than commercially operated sources and material spoil areas shall be subject to pollution control measures of this specification. An offsite location does not relieve the Contractor of his contractual obligation to prevent the introduction of silt or other pollutants into receiving waterways.

3.4 CONFLICT WITH FEDERAL, STATE OR LOCAL LAWS, RULES OR REGULATIONS
A. In case of conflict between these requirements and pollution control laws, rules, or regulations or other Federal, State or local agencies, the more restrictive laws, rules, or regulations shall apply.

3.5 TEMPORARY BERM S

A. Temporary berms shall be constructed at the top of newly constructed slopes and/or transverse to grade to divert runoff and prevent erosion until permanent controls are installed and/or slopes are stabilized.

B. Construction Requirements:
   1. Berms shall be constructed to the approximate dimensions indicated on the drawings. Berms shall be machine compacted with a minimum of one pass over the entire width with a bulldozer tread, grader wheel, or other approved method.
   2. Berms must drain to a compacted outlet at a slope drain. The top width of these berms may be wider and the side slopes flatter on transverse berms to allow equipment to pass over these berms with a minimal disruption.

3.6 TEMPORARY SEEDING AND MULCHING

A. General
   1. This item is applicable to all projects.
   2. Seeding and/or mulching shall be a continuous operation on all cut slopes, fill slopes, and borrow pits during the construction process. All disturbed areas shall be seeded and mulched within five (5) working days after the last construction activity in all locations where necessary to eliminate erosion.

B. Construction Requirements:
   1. Permanent seeding and mulching following temporary seeding will be performed during the favorable seeding seasons only.
   2. Temporary seeding mixtures and planting season:
      a. December 1 to March 1: 50 lbs. oat grain per acre
      b. March 1 to December 1: 50 lbs. (cereal rye or wheat) per acre
   3. Temporary mulch, fertilizer, and lime for seeding:
   4. Fertilizer and mulch for temporary seed mixtures shall be commercial type applied at the rate specified by the manufacturer.
   5. Lime will not be required.

3.7 STRAW BALE S

D. General
   1. Install at the bottom of embankment slopes less than 10’ high to divert runoff from sheet flow and intercept some of the sediment in the sheet flow.
   2. Install as ditch checks in small ditches and drainage areas.
   3. Install on the lower side of cleared areas to catch sediment from sheet flow.

E. Construction Requirements:
   1. Bales of straw shall be utilized to control erosion, trap sediment, and divert runoff.
   2. Bales must be adequately braced from behind.
3.8 SILT FENCE

F. General
1. Install along the toe of fills over 10’ in height, along the right-of-way line, parallel to drainageways or around an inlet to prevent sediment from entering the pipe system.

G. General Requirements:
1. The Contractor shall install a temporary silt fence in locations shown on the drawings, around inlets that accept flows containing silt, and other locations necessary to prevent the discharge of silt from the site.
2. Installation shall conform to the detail at the end of this section.
3. Fence construction shall be adequate to handle the stress from hydraulic and sediment loading.

H. Installation
1. Geotextile at the bottom of the fence shall be buried as indicated on the detail.
2. The trench shall be backfilled and the soil compacted over the geotextile. The geotextile shall be spliced together as indicated on the detail.

I. Post Installation
1. Post spacing shall not exceed 8’ for wire support fence installation or 5’ for self-supported installations.
2. Posts shall be driven a minimum of 24” into the ground. Where rock is encountered, posts shall be installed in a manner approved by the Owner’s Representative.
3. Closer spacing, greater embedment depth and/or wider posts shall be used in low areas, soft, or swampy ground to ensure adequate resistance to applied loads.
4. When support fence is used, the mesh shall be fastened securely to the upstream side of the post.
5. The mesh shall extend into the trench a minimum of 2” and extend a maximum of 36” above the original ground surface.
6. When self-supported fence is used, the geotextile shall be securely fastened to fence posts.

J. Maintenance
1. The Contractor shall maintain the integrity of silt fences as long as they are necessary to contain sediment runoff.
2. The Contractor shall inspect all temporary silt fences immediately after each rainfall. Inspect daily during prolonged rainfall.
3. The Contractor shall immediately correct deficiencies.
4. The Contractor shall make a daily review of the location of silt fences in areas where construction activities have changed the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness.
5. Where a single fence is not adequate to handle the volume of silt or flows are not completely intercepted, additional silt fences shall be installed.
6. The Contractor shall remove and dispose of sediment deposits when the deposit approaches one-half the height of the fence.
7. The silt fence shall remain in place until the upstream surface is stabilized. Upon removal, the Contractor shall remove the silt fence, dispose of excess silt, and restore the disturbed area.

3.9 SEDIMENT REMOVAL

K. General

L. Sediment deposits shall be removed when:
M. The deposits reach approximately one-half the height of a ditch check, straw bale barrier or silt fence.

N. The sediments have reduced the ponded volume of sediment basins to one-third of the original volume.

O. Requested by the Owner's Representative.

P. Sediment removed from erosion control features shall be deposited in a location where it will not erode into construction areas or watercourses.

END OF SECTION 31 2500
SECTION 32 1216 - ASPHALT PAVING

PART 1 GENERAL

1.1 SUMMARY
A. Placement of asphaltic concrete, in one or more courses, on prepared base or underlying course in conformity with the line, grade, thickness, and typical cross section shown on the drawings.

PART 2 PRODUCTS

2.1 MATERIALS
A. Materials and composition of Plant Mix Bituminous Base shall conform to MODOT 401.2 through 401.4.5 inclusive.

PART 3 EXECUTION

3.1 EQUIPMENT
A. Equipment shall meet the requirements of MODOT 403.7 through 403.9.

3.2 WEATHER LIMITATIONS
A. Asphalt shall not be placed when either the air temperature or the temperature of the surface on which the mixture is to be placed is below 50 degrees Fahrenheit for the surface course or below 40 degrees Fahrenheit for the subsurface courses. It shall not be placed on any wet or frozen surface. It shall not be placed when weather conditions prevent the proper handling or finishing of the mixture.

3.3 SPREADING AND FINISHING
A. Spreading and finishing shall conform to MODOT 403.13 through 403.16.2
B. Spot Wedging and surface leveling shall conform to MODOT 402.10.4 through 402.10.9
C. The surface of each layer shall be substantially free from waves or irregularities

END OF SECTION 32 1216
PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Driveways.
   2. Roadways.
   3. Parking lots.
   4. Curbs and Gutters.
   5. Walks.
   6. Track and field items.

1.3 DEFINITION

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

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

B. Other Action Submittals:
   a. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

C. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.

D. Material Certificates: For the following, from manufacturer:
   a. Cementitious materials.
   b. Steel reinforcement and reinforcement accessories.
   c. Welded wire fabric.
   d. Admixtures.
   e. Curing compounds.
   f. Applied finish materials
   g. Joint fillers
E. Material Test Reports: For each of the following:
   a. Aggregates

F. Field quality-control reports.

G. Submit certification that joint sealant has been installed in accordance with the manufacturer’s instructions. Include a copy of written instructions.

1.5 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
   a. Manufacturer certified according to NRMCA’s “Certification of Ready Mixed Concrete Production Facilities” (Quality Control Manual –Section 3, “Plant Certification Checklist”).

B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
   a. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

C. ACI Publications: Comply with ACI 301 unless otherwise indicated.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities

PART 2 – PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
   a. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from galvanized steel wire into flat sheets.
B. Joint Dowel Bars: ASTM A 615/ A 615M, Grade 60 (Grade 420) plain-steel bars. Cut bars true to length with ends square and free of burrs.

### 2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout the Project:
   a. Portland Cement: ASTM C150, Type 1 or 2 Portland Cement.

B. Normal Weight Aggregates: ASTM C33, uniformly graded. Provide aggregates from a single source.
   b. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: Potable and complying with ASTM C 94 / C 94M


E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
   a. Water-Reducing Admixture: ASTM C494 / C494M, Type A.
   b. Retarding Admixture: ASTM C494 / C494M, Type B.
   c. Water-Reducing and Retarding Admixture: ASTM C494 / C494M, Type D.
   d. High-Range, Water-Reducing Admixture: ASTM C494 / C494M, Type F.
   e. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494 / C494M, Type G.
   f. Plasticizing and Retarding Admixture: ASTM C 1017 / C1017M, Type 2.

### 2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sqyd. (305 g/sqm) dry.

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

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      i. Axim Italcementi Group, Inc: Caltexol CIMFILM.
      ii. BASF Construction Chemicals, LLC; Confilm.
      iii. ChemMassters: Spray-Film.
      iv. Conspec by Dayton Superior: Aquafilm.
      v. Dayton Superior Corporation: Sure Film (J-74).
      vi. Edoco by Dayton Superior; BurkeFilm.
      vii. Euclid Chemical Company (The), an RPM company, Eucobar.
viii. Kaufman Products, Inc.: VaporAid,
ix. Lambert Corporation: LAMBCO Skin.
x. L&M Construction Chemicals, Inc.; E-CON.
xi. Meadows, W. R., Inc.; EVAPRE.
xii. Metalcrete Industries: Waterhold.
xiii. Nox-Crete Products Group; MONOFILM.
xiv. Sika Corporation, Inc.; SikaFilm.
xv. SpecChem, LLC.; SpecFilm.
xvi. Symons by Dayton Superior; Finishing Aid.
xvii. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
xviii. Unitex; PRO-FILM.
ix. Vexcon Chemicals Inc.; Certi-Vex EnviroAssist.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipation.

a. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work Include, but are not limited to, the following:
i. Anti-Hydro International, Inc.; A-H Curing Compound #2 DR WB.
iii. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
iv. Euclid Chemical Company (The), an RPM company; Kurez W VOX.
vi. Lambert Corporation; AQUA KURE – CLEAR.
vii. L&M Construction Chemicals, Inc.; L&M CURE R.
viii. Meadows, R. W., Inc.; 1100-CLEAR SERIES.
ix. Nox-Crete Products Group; Resin Cure E.
x. SpecChem, LLC; PaveCure Rez.
xi. Symons by Dayton Superior; Resi-Chem Clear.
xii. Tamms Industries, Inc.; TAMMSCURE WB 30C.
xiii. Vexcon Chemicals Inc.; Certi-Vex Envirocure 100.

2.5 RELATED MATERIAL

A. Joint Fillers: Resilient premolded bituminous impregnated fiberboard units complying with ASTM D994, D1751, D2628; FS HH-F-341, Type 2 Class A.

B. Joint Sealants; ASTM C920, non-priming, pourable, self-leveling polyurethane.

C. Water repellent and chloride screen; Prosoco Saltguard WB.

2.6 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

a. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.

b. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.

B. Proportion mixtures to provide normal-weight concrete with the following properties:
b. Maximum Water-Cementitious Materials Ratio at point of placement: 0.45.
c. Slump Limit: 4 inches, plus or minus 1 inch.

C. Add air-entraining admixture at manufacturer’s prescribed rate to result in normal-weight concrete at point of placement having and air content as follows:
   a. Air Content: 6 percent plus or minus 1.5 percent for ¾ inch nominal maximum aggregate size.

D. Chemical Admixtures: Use admixtures according to manufacturer’s written instructions.
   a. Use plasticizing and retarding admixture in concrete as required for placement and workability.
   b. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

E. Cementitious Materials: Limit percentage by weight of cementitious materials other than Portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94. Furnish batch certificates for each batch discharged and used in the Work.
   a. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1.5 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excessive yielding.
   a. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
   b. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
   c. Correct subbase with soft spots and areas of pumping or rutting exceeding depths of 1/2 inch according to requirements in Division 31 Section “Earth Moving.”

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

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.
3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI’s “Manual of Standard Practice” for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

A. General: Form expansion, sawed or premolded strip, and keyed construction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
   a. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Keyed Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
   a. Continue steel reinforcement across construction joints unless otherwise indicated.
      Do not continue reinforcement through sides of paving strips unless otherwise indicated.
   b. Construct joints in accordance with details as shown in Plans.

C. Expansion Joints: Locate expansion joints as shown and detailed in the Plans and as follows:
   a. Locate expansion joints at intervals of 150 feet maximum each way unless otherwise indicated.
   b. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed caps. Remove protective cap after concrete has been placed on both sides of joint.

D. Sawed or Premolded Strip Joints: Provide a joint plan for approval by Owner. Joint spacing shall not exceed 15 feet maximum. Panels shall be cut such that panels are nearly square and do not exceed 1.4 length to width ratio.
a. Construct joints for depths equal to at least 1/3 of the concrete thickness.
b. Sawed Joints: Form joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8 inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/8 inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

F. Joint Fillers: Extend joint filler full-width and depth of joint, and not less than ½ inch or more than 1 inch below finished surface where joint sealer is indicated. Furnish joint filler in 1 piece lengths for full width being placed, wherever possible. Where more than 1 length is required, lace or clip joint filler sections together.

G. Joint Sealants: Joints shall be sealed with approved exterior pavement joint sealants and shall be installed in accordance with manufacturer’s recommendations.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation and items to be embedded or cast in.

B. Remove snow, ice, or frost from subbase surface before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

F. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   a. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating dowels and joint devices.

G. Screed paving surface with a straight edge and strike off.

H. Commence initial floating using bull floats or darbies to impart and open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

I. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and joining.
J. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
   a. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

K. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
   a. When the air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
   b. Do not use frozen materials or materials containing snow and ice.
   c. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

L. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
   a. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be sued to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor’s option.
   b. Fog-spray forms and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
   a. Medium-to-Fine textured Broom Finish: Draw a soft-bristle broom across, float-finished concrete surface perpendicular to the line of traffic to provide a uniform, fine-line texture.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sqft per hour before and during finishing operations. Apply according to manufacturer’s written instructions and after placing, screeding, and bull floating or darbying concrete, but before float finishing.
D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by curing compound as follows:
   a. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer’s written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

F. Apply water repellant and chloride screen Prosoco Saltguard WB as directed by manufacturer and indicated in 321313 Appendix A to the following locations:
   a. New sidewalks and accessible ramps.
   b. New concrete landings, stairs, and patios at exterior doors.

3.9 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:
   c. Surface: Gap below 10-foot long, unleveled straightedge not to exceed 1/2 inch.
   d. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
   e. Lateral alignment and spacing of dowels: 1 inch
   f. Vertical alignment of dowels: 1/4 inch
   g. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
   h. Joint Spacing: 3 inches
   i. Contraction Joint Depth: Plus ¼ inch, no minus.

B. The paving tolerances noted above do not control in regards to site accessibility, and providing accessible routes in accordance with the American Disabilities Act of 1990 and the 2010 ADA Standards for Accessible Design. Accessible routes shall meet the following:
   a. Sidewalks shall not exceed 5 percent slope with 2 percent cross-slope and shall be 5 feet wide except as noted on the civil plans.
   b. Parking areas for accessible spaces and access isles shall not exceed 2 percent slope in any direction.
   c. Ramps shall not exceed 8.33 percent slope with a 2 percent cross-slope and shall be 5 feet wide except as noted on the civil plans.
   d. All sidewalk intersections shall have a 5’x5’ landing with no more than 2 percent maximum slope in any direction.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C172 shall be performed according to the following requirements:
a. Testing Frequency: Obtain at least one composite sample for each 50 cu yd or fraction thereof of each concrete mixture placed each day.
   i. When frequency of testing will provide fewer than 5 compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

b. Slump: ASTM C143; one test at point of placement for each composite sample, but not less than one test for each day’s pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

c. Air Content: ASTM C231, pressure method; one test for each composite sample, but not less than one test for each day’s pour of each concrete mixture.

d. Concrete Temperature: ASTM C1064; one test hourly when air temperatures is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.

e. Compression Test Specimens: ASTM C31; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.

f. Compressive Strength Tests: ASTM C; test one specimen at seven days; two specimens at 28 days and hold one specimen in reserve for future testing, if needed.
   i. A compressive strength test shall be the average compressive strength from two specimens obtained from the same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to the Owner, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project Identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7-day and 28-day tests.

E. Nondestructive Testing: Sonoscope or other nondestructive device may be permitted by Owner but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by the Owner.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor’s expense, will be performed to determine compliance of replaced or additional work within specified requirements.

I. Prepare test and inspection reports.

3.11 REPAIRS AND PROTECTION
A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by the Owner.

B. Drill test cores, where directed by the Owner, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from newly paved areas for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 1313
PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   a. Cold-applied joint sealants.

B. Related Sections:
   a. Division 32 1313 Section “Concrete Paving” for constructing joints in concrete pavement.

1.3 SUBMITTALS

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

B. Pavement-Joint-Sealant Schedule: Include the following information:
   a. Joint-sealant application, joint location, and designation.
   b. Joint-sealant manufacturer and product name.
   c. Joint-sealant formulation.
   d. Joint-sealant color.

C. Qualification Data: For qualified installer

D. Product Certificates: For each type of joint sealant and accessory, from manufacturer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for joint sealants.

F. Preconstruction Compatibility and Adhesion Test Reports: From joint-sealant manufacturer, indicating the following:
   a. Materials forming joint substrates and joint-sealant backings have been tested for compatibility with and adhesion to joint sealants.
   b. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer’s authorized representative who is trained and approved for installation of units required for this Project.
B. **Source Limitations:** Obtain each type of joint sealant from a single source from a single manufacturer.

### 1.5 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   a. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
   b. When joint substrates are wet.
   c. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   d. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrate.

### PART 2 – PRODUCTS

#### 2.1 MATERIALS

A. **Compatibility:** Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

#### 2.2 COLD-APPLIED JOINT SEALANTS

A. **Single-Component, Nonsag, Silicone Joint Sealant for Concrete:** ASTM D 5893, Type NS.
   a. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work, include, but are not limited to, the following:
      i. Crafco, Inc., and ERGON company, Road Saver Silicone.
      ii. Dow Corning Corporation; 888.
      iii. Pecora Corporation; 301 NS.

B. **Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete:** ASTM D 5893, Type SL.
   a. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work, include, but are not limited to, the following:
      i. Crafco, Inc., and ERGON company, Road Saver Silicone SL.
      ii. Dow Corning Corporation; 890-SL.
      iii. Pecora Corporation; 301 SL.

C. **Multi-Component, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete:** ASTM C 920, Type M, Grade P, Class 25, for Use T.
   a. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      i. Pecora Corporation; Urexpan NR-200
2.3 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold and Hot Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Round Baker Rods for Cold Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

D. Backer Strips for Cold and Hot Applied Joint Sealants: ASTM D 5249, Type 2, of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.4 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer’s written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer’s written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS
A. General: Comply with joint-sealant manufacturer’s written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install joint-sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   a. Do not leave gaps between ends of joint-sealant backings.
   b. Do not stretch, twist, puncture, or tear joint-sealant backings.
   c. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
   a. Place joint sealants so they directly contact and fully wet joint substrates.
   b. Completely fill recesses in each joint configuration.
   c. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensue contact and adhesion of sealant with sides of joint:
   a. Remove excess joint sealant from surfaces adjacent to joints.
   b. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer’s written instructions unless otherwise indicated.

3.4 CLEANING

A. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at the time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.6 PAVEMENT JOINT SEALANT SCHEDULE

A. Joint Sealant Application: Joints within cement concrete pavement.
a. **Joint Location:**
   i. Expansion and isolation joints in cast-in-place concrete pavement.
   ii. Contraction joints in cast-in-place concrete.
   iii. All other joints as indicated
b. **Silicone Joint Sealant for Concrete:** Single component, self-leveling.
c. **Urethane Joint Sealant for Concrete:** Multi-component, pourable, traffic-grade.
d. **Joint-Sealant Color:** Concrete gray, limestone or color that matches adjacent concrete color.

END OF SECTION 32 1373
PART 1 GENERAL

1.1 SUMMARY OF WORK INCLUDED

A. Cleaning and preparation of surfaces to receive paint striping with a high-pressure water sprayer. Only the surfaces for striping require cleaning.

B. Painting in parking lines, safety zones, handicap zones, loading zones, no parking zones in parking lots indicated on drawings.

C. Protecting adjacent surfaces from paint drips, spatters and overspray

D. Protect wet paint from vehicular and pedestrian traffic.

PART 2 PRODUCTS

2.1 PAINT

A. Paint for parking lot striping shall be chlorinated rubber conforming to TT-P11SF epoxy pavement marking material without glass beads.

B. Paint type must be compatible with the surfaces to be painted.

2.2 COLORS

A. Paint shall be applied per the following color code: White for standard parking space lines and sidewalk crossings. Blue for handicap parking stall and symbols.

2.3 MATERIALS

A. Materials shall include standard commercial grade masking materials, scrapers, cleaning solvents, and other materials required for the work.

B. Use materials specified by manufacturer’s direction label on container.

2.4 DELIVERY AND STORAGE

A. Deliver materials in original containers with seals unbroken and labels intact.

B. Protect all paint from freezing.

C. Do not allow paint to settle, cake, or thicken in the container. Readily stir with a paddle to a smooth consistency.

D. Paint shall arrive on the job color-mixed except for tinting of undercoats and possible thinning.
PART 3 EXECUTION

3.1 PROTECTION

A. Prior to beginning cleaning or painting operations, contractor shall protect all items or surfaces not included in area to be painted. Protect vehicles, equipment, structures, or other items from paint spatters, over spray, or damage.

B. Contractor shall provide barricades and any signage needed to protect all painted areas from pedestrian and vehicular traffic until achieving sufficient drying time.

3.2 INSTALLATION REQUIREMENTS

A. Perform painting as soon as feasible and practical after the finishing of the pavement or as directed by the owners representative.

B. Adequate lighting shall be available at the time of painting.

C. Examine all surfaces to receive paint to make sure there are no defects in the surface to be striped. Do not paint over rust, scale, grease, oil, fuel, dust, wet pavement, or other conditions detrimental to paint adhesion. Remove grease, oil, or fuel on any surface before painting. Correct all surface defects before painting.

D. Contractor shall examine areas to be painted. Notify the owners representative in writing of conditions that might delay timely completion of the work.

3.3 WEATHER CONDITIONS

A. Painting shall not be performed when the ambient temperature is less than 55 degrees Fahrenheit, or while the surface is damp.

B. The surface must be five degrees or more above the dew point temperature during painting operations and while paint is drying.

3.4 APPLICATION

A. Areas to be painted shall receive one coat of paint not less than 25 mils thickness wet per MODOT 620.9 through 620.9.3.4.2. In locations requiring multiple coats, prior coat shall be dry to manufacturer’s recommendations before applying the next coat.

B. Finished work shall be uniform, of approved color, free of runs, drips, defective brushing, spraying, and clogging. Parking lines and symbols shall be neat and well defined. Only skilled applicators shall apply paint. Owners representative shall approve application techniques.

3.5 QUALITY CONTROL

A. Remove paint splatter from adjacent areas or areas not designated to receive paint.

B. Contractor shall repair or touch up any surfaces if exposed to vehicular and pedestrian traffic, to the satisfaction of the owner’s representative, at no additional cost to the owner.

END OF SECTION 32 1723
SECTION 32 3913
METAL BOLLARDS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Bollards.

1.02 SUBMITTALS
   A. See Division One for Submittal Procedures.
   B. Product Data: Provide manufacturer's specifications and descriptive literature, installation
      instructions, and maintenance information.
   C. Shop Drawings: Indicate plans for each unit or groups of units, elevations with model number,
      overall dimensions; construction, and anchorage details.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Steel Pipe Bollards:

2.02 BOLLARDS
   A. Interior Steel Pipe Bollards:
         a. Substitutions: See Division One.
      2. Shape: Round.
      4. Height: 42 inches.
      7. Materials:
   B. Exterior Steel Pipe Bollards:
      1. Basis-of-Design: Reliance Foundry Co. Ltd.; Model R-1007-08 Steel Pipe Security
         Bollard.
         a. Substitutions: See Division One.
      2. Shape: Round.
      3. Diameter: 8 inches, nominal.
      4. Height: 48 inches.
      5. Cap: Domed concrete (see drawings).
      6. Materials:
         a. Steel Pipe: ASTM 500 B.
         b. Factory primed for field painting.
         c. Mounting: In-Ground.
PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that mounting surfaces, preinstalled anchor bolts, or other mounting devices are properly installed; and ready to receive site furnishing items.

B. Do not begin installation until unacceptable conditions are corrected.

3.02 INSTALLATION

A. Install bollards in accordance with approved shop drawings, and manufacturer's installation instructions.

B. Install bollards plumb and level.

C. See Drawings for exterior bollard infill and underground encasement.

END OF SECTION
SECTION 32 9200  
TURF AND GRASSES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   a. Hydroseeding.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and mollusccides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that can cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site topsoil meeting the definition in section 31 1000 Site Clearing, stockpiled during grading operations and not heavily compacted.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 REQUIRED SUBMITTALS:

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
   a. Certification of each seed mixture. Include identification and location of source and name and telephone number of supplier.

C. Product Certificates: For fertilizers, from manufacturer.
D. Pesticides and Herbicides: Product label and manufacturer’s application instructions specific to Project.

E. Product specifications and certifications for Hydroseed. Include identification and location of source and name and telephone number of supplier.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during calendar year.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.
   a. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare network or the American Nursery and Landscape Association.
   b. Experience: Three years’ experience in turf installation in addition to requirements in Section 014000 “Quality Requirements.”
   c. Installer’s Field Supervisions: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
   d. Pesticide Applicator: State licensed, commercial.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Bulk Materials:
   a. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
   b. Provide erosion-control measures to prevent erosion displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
   c. Accompany each deliver of bulk materials with appropriate certificates.

1.8 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods:
   a. Spring Planting: March 15 to May 15
   b. Fall Planting: September 1 to October 20.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer’s written instructions.
PART 2 – PRODUCTS

2.1 FERTILIZERS

A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
   a. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

2.2 HYDROSEEDING

A. Provide fresh, clean, new-crop seed complying with tolerance for purity and germination established by Official Seed Analysis of North America. Provide seed of grass species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed, as specified.

B. Hydraulic Mulch: HydraCM matrix by North American Green, or approved equal. See Appendix for product specification.

C. Permanent Grass Seed Mix: Proportioned by weight as follows:
   a. 85 percent tall turf type fescue cultivars (Festuca arundinacea variety).
   b. 15 percent perennial ryegrass (Lolium perenne).

D. Temporary Grass Seed Mix: Proportioned by weight as follows:
   a. 50 percent wheat
   b. 50 percent oats

2.3 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below any mulch layers.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
a. 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 the soil within the planting area.
b. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
c. Uniformly moisten excessively dry soil that is not workable or which is dusty.

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

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by the Design Team 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.
   a. Protect adjacent and adjoining areas, structures, pavement pads, etc. from hydroseeding overspray.
   b. Protect grade stakes set by others until directed to remove them.

3.3 TURF AREA PREPARATION

A. Placing Planting Soil: To thickness and grades indicated in civil plans. Provide light compaction only per Section 31 2000 Earth Moving.

B. Kill and remove all existing weeds.

C. Verify all areas match the grading plan in the civil plans and provide positive drainage as intended in the plans.

D. Rake all areas smooth with no bumps, depressions, rills, or eroded areas deeper than ½”.

E. Remove all objects on the surface (typically rocks, roots, trash, broken concrete, etc.) larger than 2” in any dimension. Fill depressions left with topsoil.

F. Moisten prepared area before planting if soil is dry. Water thoroughly an allow surface to dry before planting. Do not create muddy soil.

G. Before planting, obtain Owner’s acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

H. Place fertilizer at a rate of 7 lbs/1000 sq ft or as recommended by the manufacturer.

3.4 HYDROSEEDING

A. Hydroseeding: Mix specified permanent grass seed mix, temporary grass seed mix, and HydraCM per manufacturer’s written requirements. Continue mixing until uniformly blended into a homogeneous slurry suitable for hydraulic application.
   a. Permanent grass seed mix shall be mixed so 215 lb/acre is applied.
b. Temporary seed mix shall be mixed so 10lb/acre is applied.
c. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that HydraCM component is deposited at not less than 3000 lb/acre dry weight.

3.5 TURF MAINTENANCE

A. Protection: Protect the area against traffic or other use by placing warning signs, fences, and erecting any barricades that may be required before or immediately after sowing is completed.

B. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
   a. 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.
   b. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
   c. 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 to reduce hazards.

C. Watering: Install and maintain water trucks, temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.
   a. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system (or use permanent irrigation system) to avoid walking over muddy or newly planted areas.
   b. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
   c. Onsite water may be used once the water lines are constructed and functional. Coordinate usage with the Owner.

D. Turf Postfertilization: Apply slow-release fertilizer after initial mowing and when grass is dry.
   a. Apply fertilizer at a rate of at least 7 lb/1000 sq ft of turf area.

3.6 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by the Owner:
   a. Satisfactory seeded turf: A healthy, uniform, recently mowed, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq ft area and bare spots do not exceed 3 by 3 inches.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

C. Obtain approval of satisfactory turf for all areas by Owner.
3.7 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to manufacturer’s written recommendations. Coordinate applications with Owner’s operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer’s written recommendations.

3.8 CLEANUP AND PROTECTION

A. Promptly remove the soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove waste material, trash, and debris, and legally dispose of them off Owner’s property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout maintenance period and remove as approved by Owner.

3.9 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape installer. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but not for less than the following periods:
   a. Seeded Turf: As long as required until satisfactory turf is established and approved by Owner.

END OF SECTION 32 9200
PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for water service and fire-service mains.

B. Utility-furnished products include water meters that will be furnished to the site and installed by the Utility.

1.3 DEFINITIONS

A. EPDM: Ethylene propylene diene terpolymer rubber.

B. PVC: Polyvinyl chloride plastic.

C. Utility: City of Columbia Water and Light Department

1.4 SUBMITTALS

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

B. Field quality-control test reports.

C. Operation and Maintenance Data: For water valves and specialties to include emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   a. Comply with requirements of utility company supplying water, include tapping of water mains and backflow prevention.
   b. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
   c. Comply with standards of authorities having jurisdiction for fire-suppression water service piping, including materials, hose threads, installation, and testing.
1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to following:
   a. Ensure that valves are dry and internally protected against rust and corrosion.
   b. Protect valves against damage to threaded ends and flange faces.
   c. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage:
   a. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
   b. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Water Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary water-distribution service according to requirements indicated:
   a. Coordinate all interruptions with utility company supplying water.
   b. Do not proceed with interruption of water-distribution service without permission from Owner and utility company supplying water.

1.8 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 – PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC, AWWA Pipe: AWWA C900, SDR No. 21, Class 200, with bell end with gasket, and with spigot end.
B. PVC, AWWA Pipe: AWWA C900, Class 200, with bell end with gasket, and with spigot end.
   a. Comply with UL 1285 for fire-service mains if indicated.
   b. PVC Fabricated Fittings: AWWA C900, Class 200, with bell and spigot or double bell ends. Include elastomeric gasket in each bell.
   c. PVC Molded Fittings: AWWA C907, Class 200, with bell and spigot or double-bell ends. Include elastomeric gasket in each bell.
   d. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile or gray iron standard pattern or AWWA C153, ductile iron compact pattern.
      i. Gaskets: AWWA C111, rubber.
   e. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile or gray iron standard pattern or AWWA C153, ductile iron compact pattern.
      i. Glands, Gaskets, and Bolts: AWWA C111, ductile or gray iron glands, rubber gaskets, and steel bolts.

2.2 JOINING MATERIALS

A. Plastic Pipe Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.3 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.4 GATE VALVES

A. AWWA, Cast Iron Gate Valves:
   a. All valves and accessories shall comply with the current Utility Specifications for water main construction.
   b. Manufacturers: Subject to compliance with Utility requirements, acceptable by Utility.

2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:
   a. All tapping sleeves and accessories shall comply with the current Utility specifications.
   b. Manufacturers: Subject to compliance with Utility requirements, acceptable to Utility

2.6 CHECK VALVES

A. AWWA, Check Valves:
   a. All valves and accessories shall comply with current Utility Specifications.
   b. Manufacturers: Subject to compliance with Utility requirements.
   c. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.
      i. Standard: AWWA C508
      ii. Pressure Rating: 200 psig.
2.7 CORPORATION VALVES AND CURB VALVES

A. General: As required by Utility company supplying water.

B. Manufacturers: Per current Utility Specifications.

2.8 FIRE HYDRANTS

A. Traffic Model, Dry-Barrel Fire Hydrants with compression valve:
   a. All fire hydrants shall comply with current Utility Specifications for Water Main Construction.
   b. Manufacturers: Subject to compliance with Utility requirements. Provide products in accordance with Utility Specifications.

PART 3 – EXECUTION

3.1 EARTHWORK

A. Refer to Section 31 2000 “Earth Moving” for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fitting with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

3.3 PIPING INSTALLATION

A. Water Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

B. Water Main Connection: Tap water main according to requirements of water utility and of size and location indicated.

C. Make connections larger than NPS 2 with tapping machine according to the following:
   a. Install tapping sleeve and tapping valve according to MSS SP-60
   b. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
   c. Use tapping machine compatible with valve and tapping sleeve; cut in main. Remove tapping machine and connect water service piping.
   d. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

D. Comply with NFPA 24 for fire service main piping materials and installation.
E. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

F. Bury piping with depth of cover over top at least 48 inches below finish grade.

G. Install piping by City of Columbia trenchless methods, under streets and other obstructions that cannot be disturbed.

H. Extend water service piping and connect to water supply source in locations and pipe sizes indicated.

I. 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 as needed or required.

3.4 JOINT CONSTRUCTION

A. Make pipe joints according to the following:
   a. PVC piping gasketed joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricate according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer’s written instructions.

3.5 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water distribution piping with restrained joints. Anchorages and restrained joint types that may be used include the following:
   a. Concrete thrust blocks.
   b. Thrust Collars.
   c. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bens, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

3.6 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. Valve boxes shall be in compliance with Utility Specifications, and as detailed within the civil plans.

B. AWWA Valves other than gate valves: Comply with AWWA C600 and AWWA M

3.7 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to Utility company’s specifications. Meter installation will be performed by the Utility company.
3.8 WATER METER BOX INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valve and test cocks. Install according to requirements of plumbing and health department authorities having jurisdiction.

3.9 BACKFLOW PREVENTER INSTALLATION

A. 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.

3.10 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant with separate gate valve in supply piping, anchor with restrained joints or thrust blocks, and support in upright position. Fire hydrants shall be installed per current Utility Specifications, and as detailed within the plans.

B. Supply pipe shall have a minimum cover of 42 inches.

3.11 CONNECTIONS

A. Install all exterior water piping connections per current Utility Specifications and construction requirements.

B. Connect water distribution piping to utility in water main, in accordance with Utility requirements. Use tapping sleeve and tapping valve.

3.12 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than on-and-one-half times the working pressure for two hours or as required by the Utility company.

C. Prepare reports of testing activities as needed.

D. Conduct all waterline tests required by Utility and obtain Utility acceptance of all lines to be public.

3.13 IDENTIFICATION
A. Install continuous underground THHN-12 solid blue locator wire. All installation and connections shall be per the current Utility Specifications, and as detailed in the civil plans. Underground warning tapes are specified in Section 31 2000 “Earth Moving”.

3.14 CLEANING

A. Clean and disinfect water-distribution piping as follows:
   a. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before used.
   b. 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.
   c. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
      i. Fill system or part of system with water/chlorine solution containing at least 50 ppm or chlorine; isolate and allow to stand for 24 hours.
      ii. Drain system or part of system or previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
      iii. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
      iv. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
      v. Obtain approval of Utility and Owner.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 33 1113